# THE JOURNAL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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ANNUAL MEETING PAPERS CONTINUED IN THIS ISSUE

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# THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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# PREVENTABLE WASTE OF COAL IN THE UNITED STATES

## With a Consideration of Alternative Methods of Its Elimination

By DAVID MOFFAT MYERS, NEW YORK, N. Y.

Member of the Society

As a means of far-reaching economy the Government of the United States should at this time apply intelligent and direct-acting efforts to the conservation of fuel at the industrial plants which are responsible for its greatest consumption. It is unnecessary before a body of engineers to show proof that coal is wasted in vast quantities in the boiler furnaces of our plants, to feed which it is mined and distributed at a high and ever-increasing cost of labor and material.

The mining and distribution of coal have been placed under the supervision of the War Coal Board in order more nearly to meet the crying needs in these directions, to use the railroad facilities more efficiently so that the present car shortage may be minimized to the greatest possible extent, and to apportion the coal in quantity and to uses deemed most expedient.

While this organized effort to bring about efficiency in the production and distribution of coal is being made, no parallel measures have been adopted to bring about a normal and practicable efficiency in its use. The hundreds of large plants which are consuming fuel wastefully, in many cases more wastefully and carelessly than ever before, are directly and needlessly causing a large fraction of the existing car shortage. They are overloading the already strained capacity of the railroads; they are rendering slower and more difficult the transportation of food and other vital commodities, and in short they are simply counteracting the measures of efficiency in production and distribution which have elsewhere been established.

*Comprehensive abstracts of the papers to be presented and discussed at the thirty-eighth Annual Meeting of The American Society of Mechanical Engineers, to be held in the Engineering Societies Building, New York, December 4 to 7, are continued in this issue and will be concluded in the December number.*

*The abridgments here presented are supplemental to the complete papers being printed in pamphlet form. They have been prepared with the collaboration of authors and are therefore authoritative presentations of the subject-matter of the papers. In many cases the abstract omits only such sections of the complete paper as mathematical derivation of formulae, minute descriptions of apparatus, logs of tests, etc., which could not very well be curtailed.*

*As stated, all the Annual-Meeting papers appearing in The Journal are also being printed in unabridged pamphlet size for advance distribution, and members of the Society desiring a complete copy of any particular paper may obtain it upon application to the Secretary.*

*Contributed discussion of these papers for presentation at the meeting and publication in The Journal and Transactions is invited.*

### PREVENTABLE WASTE OF FUEL

The preventable waste of fuel in the boiler furnaces of one steel mill amounted to 40,000 tons per year, which at $5 a ton would cost $200,000. This was a comparatively modern plant. The efficiency of boilers and furnaces in a 14-day test was 55 per cent. The load factor was unusually favorable to high efficiency and could readily be raised to 70 per cent or over. This is only one example and there are many more extreme cases. In one hand-fired plant the evaporation was raised from 6 to 9 lb. in a few days of instruction, and continuously kept close to this higher mark with the help of coal and water measurements which were inaugurated. The saving was due exclusively to instruction and consequent better operation.

The saving or wasting of one-fourth of the coal consumption of any industrial plant depends entirely upon the efficiency of its operating management. Let me emphasize that this fraction of the consumption relates exclusively to the *boiler* plants, i.e., the production of steam; and does not include the large economies possible in connection with its distribution and use.

For well-known reasons the boiler plant offers the more lucrative field for producing economies, and these with a minimum of alteration in physical equipment.

Under present conditions a plant which carelessly operates at an efficiency of 40 to 50 per cent receives from the Government the same consideration in the delivery of coal as the one whose efficiency is 70 to 75 per cent. This obviously is unfair as well as wasteful.

The Government hands over, say, 200,000 tons of coal a year to a plant owner, but asks for no account as regards its consumption, nor any questions as to the amount of steam it is made to produce. There is nevertheless an equivalent amount of steam this fuel is capable of generating, and it can and should be made to produce that quantity.

### CONSERVATION METHODS

The object of this paper is to open a discussion which it is hoped will ultimately lead to the formulation of definite recommendations of means for the reduction of the present great preventable waste of fuel in our industries; to direct such means principally toward the elimination of that portion of the present waste which is due to faulty, careless and uninformed operation of plants; to forward these recommendations to the proper governmental authorities as an official com-

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munication of this Society, and to offer to the Government the services of the Society for the organization, furthering, and, as far as possible, the execution of the plan which may as a consequence be adopted.

In general, there are two plans of operation worthy at least of consideration. One might be termed the autocratic method. This would involve the use of authority to compel coal consumers to execute such measures of economy as the proper authorities might prescribe for any given case. Limits to be set as to expense to the user. Such limits might be in terms of a percentage of their present yearly coal bill. Alterations to be directed chiefly, as previously implied, to purely operating improvements. Many objections would probably be made by consumers against this plan, but once in effect the majority would no doubt realize its pecuniary advantage to themselves. But its tendency may be too strongly opposed to democratic principles.

The other plan would be largely an educational one, in which patriotism and efficiency would furnish the motive forces required.

The teaching must be accomplished with the utmost simplicity and directness. Above all it must be in such form as to be readily comprehended and applied. This is a big task, but with the technical and executive ability represented in this Society, these things should be and can be accomplished.

The requisite information must reach the owners and managers of industries, and there must be simple instruction sheets for the engineers and firemen. The vital importance of daily accurate records of coal and water must be taught and information given regarding practical appliances for automatic measurements of both.

Blank forms might be sent in advance to plant owners in order to be advised by them, first, whether they would be willing to coöperate with a governmental organization offering to assist them in reducing their coal consumption, and second, to obtain such data as to size, type, equipment, operation and fuel consumption of the plants as would enable a classification which would permit a Government board of experts to send such instructions as would include the information needed for any one class of plants.

This work would be greatly aided by a staff of experts ready to visit plants when so requested by owners and make investigations and recommendations and keep in touch with the progress of economies. Included in such a staff should be men intimately familiar with practical operating economies whose duties would be the delivering of lectures or talks, which should be planned so as to reach directly not only managers and owners of the industries, but also the chief engineers and firemen of the boiler plants. This feature of the plan, by itself, would undoubtedly result in great savings.

The U. S. Bureau of Mines has for a number of years engaged in obtaining and disseminating scientific information regarding the mining and consumption of coal, and the results of the work have been of great value to technical engineers who are able to use and apply it. It is evident that we now require an extension of the idea of education, but in such form as directly to affect the men who run the boiler plants of our country, for in their hands is the saving or wasting of one-fourth of our fuel supply.

Six hundred million tons of coal were mined in the United States in 1916. If we assume only one-half of this to have been used for our industrial boiler plants, then a quarter of the coal used under boilers amounts to 75,000,000 tons per year. It is worth while to save this fuel by preventing its waste. This quantity of coal represents the use of 1,500,000 fifty-ton freight cars.

# PLOTTING BLOWER-TEST CURVES

By A. H. ANDERSON, CHICAGO, ILL.

Member of the Society

***To the several methods of plotting blower-test curves another method is here added, whose utility is demonstrated by the solution of problems from graphically recorded test data. Diagrams are given for impellers with blades tilted forward, with blades radial, and with blades tilted backward, the coordinates used being revolutions per minute and static pressure in inches of water. Two series of curves are given, one showing various rates of discharge in cubic feet per second, and the other the volumes discharged per second per horsepower.***

SEVERAL ingenious methods of graphically representing centrifugal-fan characteristics are in use, and to these the writer adds another method which, to the best of his knowledge, is new.

To obtain the experimental data the fan is tested at several speeds, the discharge being varied by the use of different sized orifices. Figs. 1, 2 and 3 show the curves for three fans which differ only in the angle of inclination of the blades, the coördinates being static pressure and speed. The curves connect points of equal capacity, and also equal cubic feet per second per horsepower. The use of the charts is best illustrated by the six problems which follow.

PROBLEM 1. Required the input horsepower in Fig. 1 for 1360 r.p.m. and 2.7 in. static pressure.

*Solution:* The chart shows the fan is delivering 14.5 cu. ft. per sec. per horsepower, with a capacity of 45 cu. ft. per sec. The input horsepower, therefore, is $45/14.5 = 3.1$.

PROBLEM 2. Required the mechanical efficiency in Fig. 1 at 1360 r.p.m. and various static pressures.

*Solution:* (1) Cubic feet per second: read direct. (2) Velocity pressure: find in Table 1. (3) Dynamic or total pressure: add static and velocity pressure. (4) Output horsepower: take product of cubic feet per second, dynamic pressure, and a constant depending upon temperature and pressure (for usual conditions constant = 0.0093). (5) Input horsepower: divide cubic feet per second by cubic feet per second per horsepower. (6) Mechanical efficiency: divide output horsepower by input horsepower. These successive steps are

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tabulated below. Note that the zone of maximum efficiency is found at the concave part of the series of curves.

| Static pressure, in. water | (1) Cu. ft. per sec. | (2) Velocity pressure, in. water | (3) Total pressure, in. water | (4) Output hp | (5) Input hp. | (6) Mech. efficiency, % |
|---|---|---|---|---|---|---|
| 2.8 | 35.0 | 0.23 | 3.03 | 0.95 | 2.33 | 40.5 |
| 2.4 | 52.5 | 0.53 | 2.93 | 1.56 | 3.62 | 43.0 |
| 2.0 | 62.0 | 0.74 | 2.74 | 1.73 | 4.07 | 42.5 |
| 1.8 | 65.0 | 0.81 | 2.61 | 1.72 | 4.43 | 41.8 |

Problem 3. Required the mechanical efficiency in Fig. 2 at 1300 r.p.m. and various static pressures.

*Solution:* See method used in Problem 2 and the following tabulation.

| Static pressure, in. water | (1) Cu. ft. per sec. | (2) Velocity pressure, in. water | (3) Total pressure, in. water | (4) Output hp. | (5) Input hp. | (6) Mech. efficiency, % |
|---|---|---|---|---|---|---|
| 2.0 | 30 | 0.17 | 2.17 | 0.67 | 1.67 | 40.0 |
| 1.8 | 42 | 0.34 | 2.14 | 0.92 | 2.21 | 41.5 |
| 1.4 | 52 | 0.52 | 1.92 | 1.02 | 2.56 | 40.0 |
| 1.0 | 58 | 0.65 | 1.65 | 0.98 | 2.70 | 36.0 |

TABLE 1 VELOCITY PRESSURES IN INCHES OF WATER FOR VARIOUS RATES OF DISCHARGE

| Cu. ft. per sec. | Velocity pressure, in. | Cu. ft. per sec. | Velocity pressure, in. | Cu. ft. per sec. | Velocity pressure, in. | Cu. ft. per sec. | Velocity pressure, in. |
|---|---|---|---|---|---|---|---|
| 36 | 0.250 | 44 | 0.375 | 52 | 0.520 | 60 | 0.700 |
| 37 | 0.264 | 45 | 0.390 | 53 | 0.540 | 61 | 0.720 |
| 38 | 0.280 | 46 | 0.410 | 54 | 0.562 | 62 | 0.740 |
| 39 | 0.294 | 47 | 0.425 | 55 | 0.585 | 63 | 0.760 |
| 40 | 0.310 | 48 | 0.445 | 56 | 0.605 | 64 | 0.790 |
| 41 | 0.325 | 49 | 0.463 | 57 | 0.628 | 65 | 0.810 |
| 42 | 0.340 | 50 | 0.483 | 58 | 0.650 | .. | ..... |
| 43 | 0.357 | 51 | 0.500 | 59 | 0.670 | .. | ..... |

Note that the zone of maximum efficiency is found along the 40-cu.-ft.-per-sec. line.

Problem 4. Required the mechanical efficiency in Fig. 3 at 1400 r.p.m. and various static pressures.

*Solution:* See method used in Problem 2 and the following tabulation.

| Static pressure, in. water | (1) Cu. ft. per sec. | (2) Velocity pressure, in. water | (3) Total pressure, in. water | (4) Output hp. | (5) Input hp. | (6) Mech. efficiency, % |
|---|---|---|---|---|---|---|
| 1.6 | 30 | 0.17 | 1.77 | 0.54 | 1.58 | 34.0 |
| 1.2 | 40 | 0.31 | 1.51 | 0.61 | 1.82 | 33.5 |
| 0.8 | 48 | 0.44 | 1.24 | 0.61 | 2.08 | 29.3 |

Problem 5. Required the r.p.m. and static pressure to change from 1320 r.p.m. and 50 cu. ft. per sec. to 55 cu. ft. per sec. (Fig. 1).

*Solution:* Follow the 1320-r.p.m. line down to 50 cu. ft. per sec., where the static pressure is found to be 2.29 in. The new static pressure will then be

$$2.29 \times \frac{(55)^2}{(50)^2} = 2.77 \text{ in.}$$

The r.p.m. corresponding to a static pressure of 2.77 in. and 55 cu. ft. per sec. is 1450.

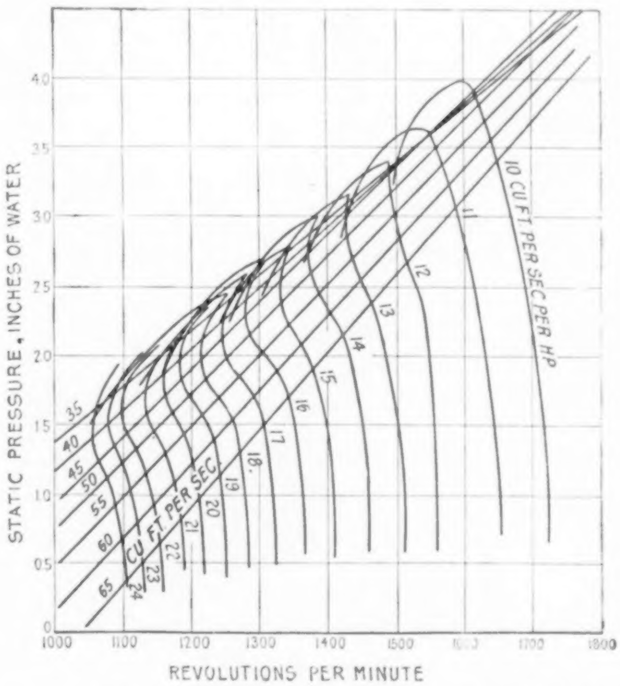


Fig. 1 Characteristic Curves, Blades Tilted Forward

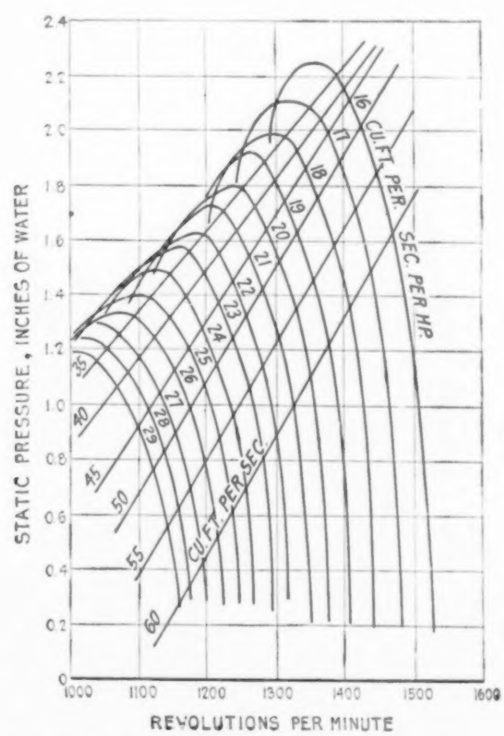


Fig. 2 Characteristic Curves, Blades Radial

Problem 6. The speed of a fan (Fig. 2) is changed from 1160 r.p.m. to 1500 r.p.m. The original static pressure is 1 in. Increase the capacity in the ratio of the speeds, 1500/1160 =

1.3, and determine ratio of new input horsepower to original, and ratio of new static pressure to original.

*Solution:* The capacity at 1 in. and 1160 r.p.m. is 48 cu. ft. per sec., therefore the new capacity will be $48 \times 1.3 = 62$ cu. ft. per sec. At 1500 r.p.m. and 62 cu. ft. per sec. the static pressure is 1.6 and the ratio is $1.6/1 = 1.6$, or approximately the square of 1.3. The horsepower at 1 in. and 1160 r.p.m. is $48/26.5 = 1.8$, and the horsepower at 1.6 in. and 1500 r.p.m. is $62/15 = 4$, the ratio being $4/1.8 = 2.2$, which is the cube of 1.3. Hence, when the capacity of a fan varies directly with the r.p.m., the static pressure varies directly with the square of the r.p.m., and the horsepower directly with the cube of the r.p.m.

The general arrangement of the apparatus for obtaining the power input is shown in Fig. 4. The fan was directly driven by a Sprague electric dynamometer, and the torque was measured by a Kron springless scale. The output apparatus is shown in Fig. 5. Dynamic pressures were obtained by a pitot tube and static pressures by a piezometer ring with four openings through the wall of the pipe. Fig. 6 shows the connections from the pitot tube and piezometer to the differential gages. This view shows also the method of securing the orifice plate to the discharge pipes.

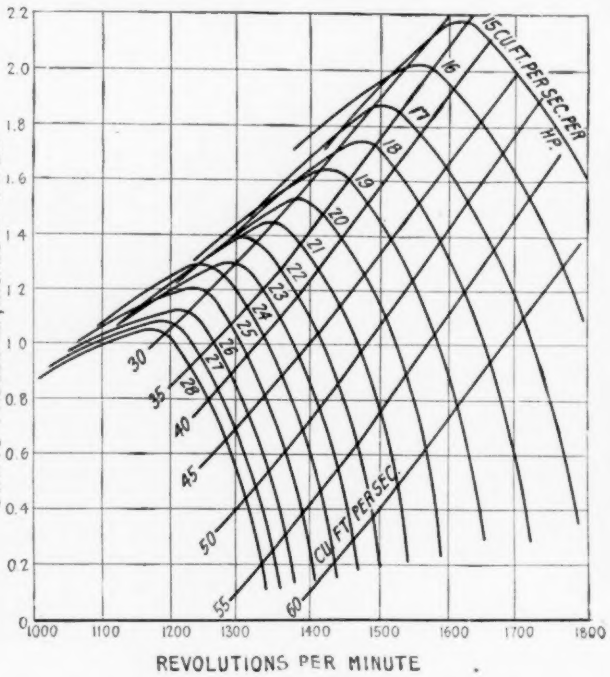


FIG. 3 CHARACTERISTIC CURVES, BLADES TILTED BACKWARD

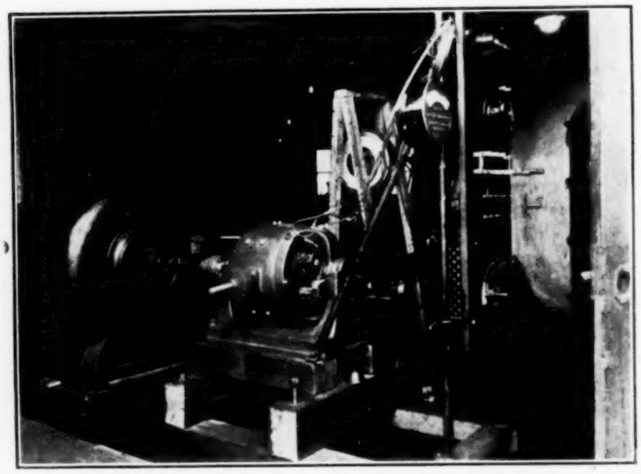

FIG. 4 APPARATUS FOR OBTAINING POWER INPUT

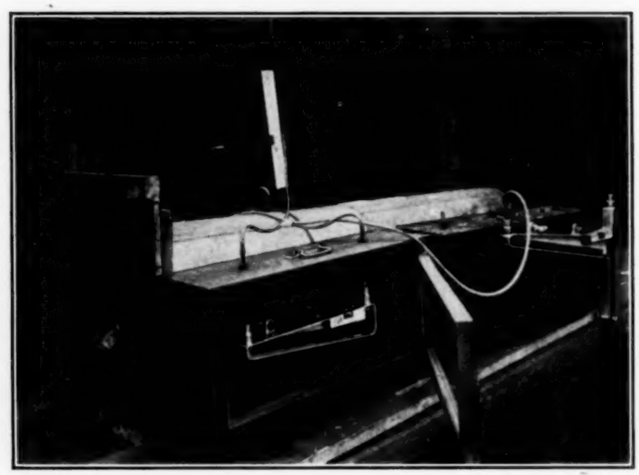

FIG. 5 APPARATUS FOR OBTAINING OUTPUT

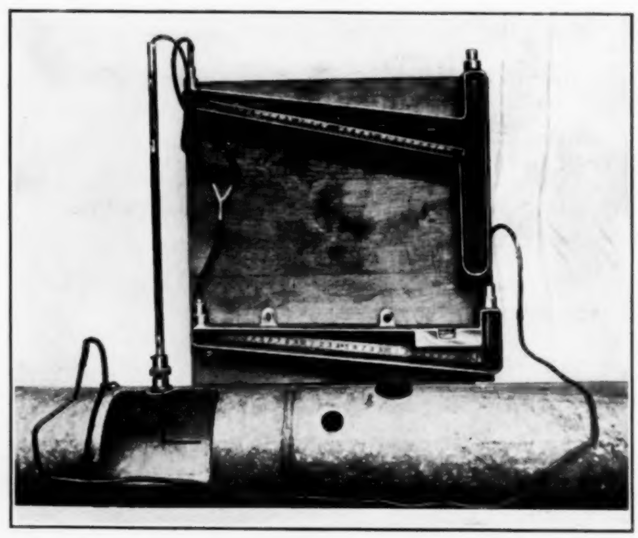

FIG. 6 CONNECTIONS TO DIFFERENTIAL GAGES

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Walter Humphreys, registrar of the Massachusetts Institute of Technology, has compiled registration statistics which indicate the effects of the war on technical education. The total registration is between eight-five and ninety per cent of what it was last year at the same time. The freshman year shows an increase, the percentage in terms of last year's figure being 104, while the second, third and fourth years' classes are, respectively, 93 per cent, 75 per cent and 86 per cent of the number in the school in June.

The graduate students stand at 60 per cent of last year's figure. There is the most shrinkage in the juniors, the sophomores of last year, to whom two years more of schooling has perhaps seemed a long time. The return of eighty-six per cent of the juniors to be seniors is evidence in favor of the junior summer camp. The purpose of this was to give some military practice and an opportunity to anticipate fourth-year studies, and complete work at an earlier date.

# THE MOISTURE CONTENT OF TEXTILES AND SOME OF ITS EFFECTS

By WILLIAM D. HARTSHORNE, METHUEN, MASS.

Member of the Society

THE smoothness and evenness of a thread are dependent upon the relation of its moisture content to the surrounding atmosphere at the time of spinning; and many of the hitherto puzzling defects in a finished fabric are explainable, and the remedy or method of prevention rendered obvious, as soon as the correct relationship of these facts to weaving and fabric-finishing conditions is apprehended. Moreover, the effects of moisture content upon strength and elasticity are not less important, both in manufacturing processes and commercial use.

The most significant effects of moisture content upon textiles may be classified under three general heads:

I Weight
II Dimensions
III Strength and Elasticity

Under these respective heads, among the different textile materials there is great diversity of effect, and as a consequence a great divergency in unverified opinion. The most obvious of these effects is weight, and to this factor the present paper is mainly devoted.

To conditions causing changes in weight much more effective study has been given than to those causing changes in dimensions or strength and elasticity. These latter are complicated by other factors, such as twist or weave, which tend to increase or diminish the ordinary effects of moisture.

### EFFECT OF MOISTURE CONTENT ON WEIGHT

In measuring weight, long before any exact causal relationship had been established between the various factors, certain standards of moisture content for the principal textile materials, such as silk, wool, cotton and flax, and their manufactured products, had been established by custom, and to some extent sanctioned by law, in the principal Continental markets and in England, as a basis for purchase and sale.

Variations in weight between different materials due to their individual hygroscopic properties as affected by atmospheric changes alone were thus recognized, and a standard basis for figuring the standard allowances agreed upon was also adopted and with few exceptions has been steadily adhered to. This standard basis was obtained by determining the average loss in moisture of a series of representative samples, from the lot of material in question, by drying them in a proper oven at a temperature of 221 to 230 deg. fahr. until they ceased to lose weight, or the rate of loss had reached a prescribed minimum.

The standard allowances made upon this "standard" dry basis of weight (sometimes called the bone-dry or the absolutely dry basis) are commercially called "regains," a nomenclature liable to misconception and misapplication which it is important at the outset to avoid both in practical use and theoretical study. The hygroscopic capacity and other properties of both wool and cotton, for instance, are well known to be materially affected both by the temperature at which they are dried and the length of exposure to a drying and oxidizing atmosphere.

With materials as valuable as silk, wool and cotton and such of their products as are sold by weight, the actual weighing of the water they may happen to contain at the time of sale is of evident importance to both buyer and seller, when it is once understood what slight changes of circumstances can cause a loss or gain in weight involving thousands of dollars in many everyday transactions.

The standard condition upon which worsted yarn and tops combed without oil have long been bought and sold in England and on the Continent allows $18\frac{1}{4}$ per cent regain or added weight to the standard dry-weight condition. The standard for silk is 11 per cent and for cotton is $8\frac{1}{2}$ per cent. Until recently no standards except for silk, which is the same the world over, had been generally recognized in the United States.

Theoretically, it makes no difference whether the standard condition of regain be assumed at one figure or another provided that the actual condition is known and that some standard has been agreed upon between buyer and seller. Practically, however, it is desirable that the standard condition be somewhere near the average expected for the country in which the transaction takes place, and that at the time of delivery the material shall in its whole mass be as near as may be in this standard condition.

### CORROBORATION OF 15 PER CENT REGAIN FOR WORSTED

The importation of worsted yarns and tops into this country under foreign exporting conditions, owing to the loss of weight sustained upon storage here, had given the impression that there must be at least 2 or 3 per cent difference in weight due to climatic reasons.

It was important, therefore, in developing the new American industry of combing tops for the trade to adopt a standard believed to be safe for this country. This was put at the arbitrary figure of 15 per cent regain, an amount easy to calculate and also within expected limits. It seemed best, however, to determine with some degree of certainty how near this figure was to the average natural condition corresponding to some one locality, such as Lawrence, Mass.

With this object in view, a skein of worsted yarn, 2/42 Australian, combed in oil and spun on the Bradford system, was prepared whose absolute or rather "standard" dry weight was carefully determined by weighing and testing other skeins of the same material under exactly like conditions. This method of using substitute skeins was adopted to avoid the known effects of heat in changing the hygroscopic property of wool and other fibers.

Table 1 shows the variations in weight of this skein, which were remarkable, ranging from a little over 7 per cent to as high as 35 per cent on the calculated dry weight. There were occasional variations of 15 or even 19 per cent in 24 hours.

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The observations recorded in Table 1 gave for outdoor conditions a general average for the year of 17.45 per cent, or something less than the standard allowed abroad; and without attempting at the time to go further into the law of change, it was felt that at least it was demonstrated that a standard of 15 per cent regain for worsted, as had already been assumed, was conservative for this country.

## RELATION BETWEEN HUMIDITY, TEMPERATURE AND REGAIN

The determination of the exact relation between the three factors, humidity, temperature and regain, was a problem which the author had had under investigation for some time

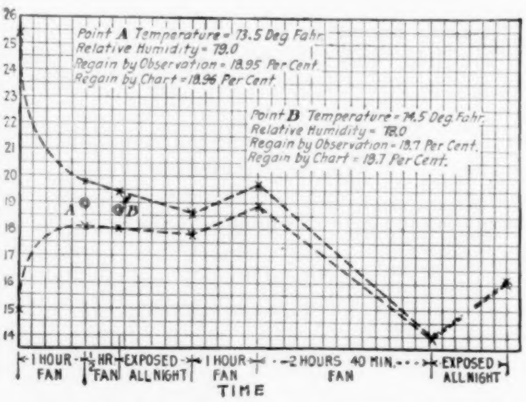


FIG. 1 LAGGING EFFECT IN SKEIN TAKING UP OR PARTING WITH MOISTURE

prior to 1905. That the absorption of moisture by worsted yarn was in some manner dependent upon relative humidity and temperature was abundantly shown by the year of exterior observations recorded, and also by many interior records made subsequently. It seemed possibly true that the atmospheric pressure affected the result, but its effect was so far overshadowed by the element of temperature that, for practical mill purposes, it was evident that the height of the barometer could be neglected. In fact, all observations for either relative humidity or skein regain were made on the assumption of 30 in. barometric pressure.

*TABLE 1 VARIATIONS IN WEIGHT OF SKEIN OF WORSTED FOR ONE YEAR

| | Lowest Day | | Highest Day | | Lowest Observation | | Highest Observation | | Greatest Difference in 24 Hours | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent | Date | Per Cent | Date | Per Cent | Date | Per Cent | | Per Cent | Date |
| May | $11^{60}$ | 17 | $21^{30}$ | 27 | $9^{7}$ | 17 | $22^{1}$ | 6 and 27 | $8^{3}$ | 6 to 7 |
| June | $13^{01}$ | 19 | $25^{92}$ | 29 | $10^{7}$ | 14 | $27^{5}$ | 28 | $10^{9}$ | 5 to 6 |
| July | $14^{95}$ | 25 | $23^{96}$ | 17 | $12^{9}$ | 3 | $26^{8}$ | 1 | $9^{1}$ | 1 to 2 |
| August | $14^{46}$ | 9 | $22^{00}$ | 13 | $12^{8}$ | 21 | $22^{9}$ | 13 | $8^{7}$ | 7 to 8 |
| September | $12^{19}$ | 24 | $23^{27}$ | 11 | $11^{5}$ | 24 | $25^{9}$ | 26 | $12^{1}$ | 26 to 27 |
| October | $13^{61}$ | 18 | $22^{71}$ | 8 | $12^{3}$ | 18 | $28^{0}$ | 14 | $11^{8}$ | 28 to 29 |
| November | $15^{59}$ | 22 | $31^{77}$ | 26 | $14^{1}$ | 4 | $35^{1}$ | 26 | $19^{1}$ | 26 to 27 |
| December | $15^{41}$ | 27 | $30^{70}$ | 2 | $13^{0}$ | 27 | $33^{7}$ | 2 | $16^{1}$ | 2 to 3 |
| January | $13^{54}$ | 4 | $34^{38}$ | 25 | $13^{0}$ | 29 | $34^{9}$ | 25 | $15^{1}$ | 24 to 25 |
| February | $12^{70}$ | 25 | $29^{92}$ | 6 | $12^{2}$ | 25 | $33^{4}$ | 6 | $17^{3}$ | 6 to 7 |
| March | $11^{02}$ | 27 | $27^{30}$ | 2 | $10^{2}$ | 27 | $28^{8}$ | 20 | $16^{4}$ | 30 to 31 |
| April | $9^{05}$ | 30 | $21^{40}$ | 2 | $7^{3}$ | 30 | $24^{0}$ | 2 | $12^{3}$ | 1 to 2 |

General average (by the month) for the year, $17^{45}$ per cent.
Lowest average periods (April), $14^{15}$, and (May), $14^{88}$ per cent.
Highest average periods (November), $22^{22}$, and (December), $19^{88}$ per cent.
Lowest observation (April 30), $7^{3}$ per cent.
Highest observation (November 26), $35^{1}$ per cent.

The first efforts toward the solution of the problem of finding the relation were directed to obtaining in a closed room, for as long a period as possible, a uniform state of moisture and temperature. The difficulty of maintaining both these factors uniform for a sufficient length of time to determine more than a very limited range of facts was found to be extremely great, if not impossible, with apparatus then available. So far as these facts were determined, they indicated that the same skein of worsted yarn can always be relied upon to reach the same weight under like conditions, if given sufficient time.

For the purpose of eliminating the effect of hard twist in retarding the absorption of moisture and the effect of oil upon the net result, a quantity of 2/24 soft twist, French spun, fine Australian yarn was prepared and extracted with ether, dried, and extracted again with warm water to which a few drops of ammonia had been added. After allowing it to hang up for some time to come to its natural state, this yarn was made up into groups of skeins of equal lengths and approximately equal weights. The final weight and moisture state of the groups was carefully determined after they had been hung up together again for about two days, by drying out individual skeins of the different groups in the ordinary ventilated Bradford oven at a temperature of from 220 to 230 deg. fahr., until they ceased to lose weight, and also by leaving small two-gram

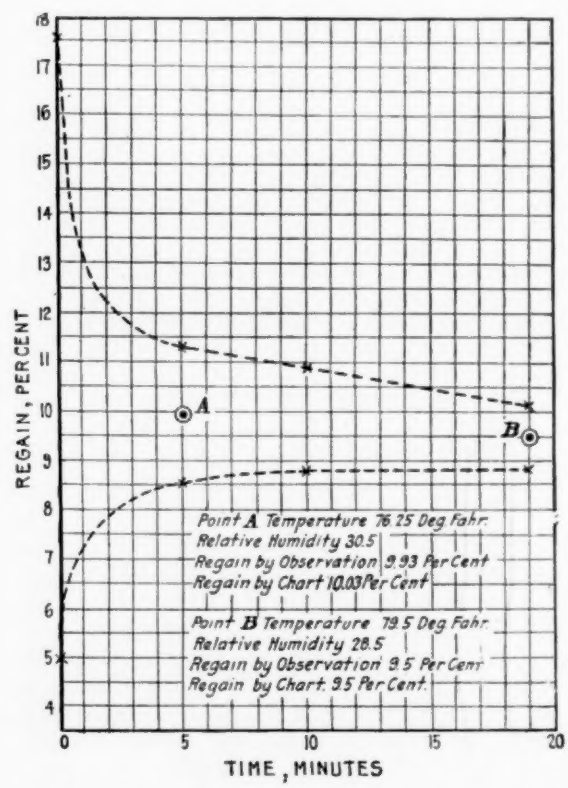


FIG. 2 LAGGING EFFECT IN SKEIN TAKING UP OR PARTING WITH MOISTURE

skeins in weighing bottles under a dessicator containing strong sulphuric acid.

These two methods were used to check each other from time to time during the experiments, to establish the true weight of the skeins being used as moisture indicators.

Attention has already been called to what has been termed the "lagging effect," due to the time required by a skein of yarn to take up or part with moisture. The effect of this is

to show for a gi·.en humidity and given temperature a higher result when the skein regain condition has been a falling one, and a lower result when that condition has been a rising one. In undertaking, therefore, a careful series of experiments, it was deemed necessary to make the skeins to be examined of such a size that they could be accurately weighed on a delicate balance, and not be so large that the amount of moisture which might be absorbed or parted with by a given skein would require a great many cubic feet of air to supply or displace it.

Upon comparing the results obtained from two skeins hung together, one of which had been previously exposed to a damp atmosphere, and the other to a comparatively dry atmosphere, it was soon found that while it might require hours or even days to bring the skeins exactly together again, the mean between the two at any time after 15 or 20 min. was practically the same in repeated experiments for the same temperature and relative humidity, and presumptively equal to what a third skein would have shown which had been a long time exposed to identical conditions. It was therefore assumed that this mean could be relied upon to quickly determine the true regain relationship for any not too rapidly changing conditions. It was thus possible to make use of the very lag effect, which had previously rendered individual observations seemingly incompatible, to establish comparatively accurate and true results. Figs. 1 and 2 are intended to illustrate this lagging-behind and coming-together effect and the method of obtaining quick results.

In order to compare the results obtained by this method, a special form of charting was devised, shown in Fig. 3 for worsted and Fig. 4 for cotton, on a scale greatly reduced from the original, where the ordinates represent regain and the abcissæ moisture per cubic foot of space, for the temperatures and relative humidities found and shown in the figures. It will be observed that the lines joining points of the same relative humidity (for example, the 50 per cent line) cross the isothermal lines in a general oblique direction, curved slightly

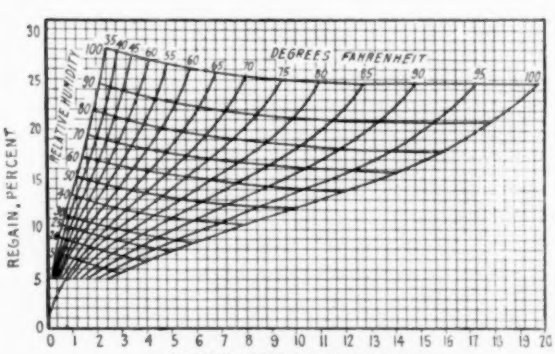


Fig. 3 Isothermal and Relative-Humidity Lines for Worsted

convex, on the downward side; that is to say, for a given relative humidity the regain is less at the higher temperature, but not less in a constant ratio.

By the aid of this charting principle, a sufficient number of points were located to trace the isothermal and the relative humidity lines shown, and from these charted results it was found possible to tabulate by interpolation the percentage regain on worsted with a fair degree of accuracy for each percentage of relative humidity from 15 per cent up to near saturation, and for isothermals 5 deg. of temperature apart from 35 deg. fahr. to 100 deg. fahr.

The data for securing the cotton chart were by no means so complete as those used for the worsted chart, and therefore the same degree of accuracy was not expected for it.

It will be seen from Figs. 3 and 4 that the regains for cotton are approximately one-half of those for worsted under like conditions, but the relative-humidity lines are more nearly straight and therefore bear a more nearly constant ratio to the regains.

Another method of comparing results is shown in Fig. 5, in which curves of saturation (100 per cent humidity), 60 per

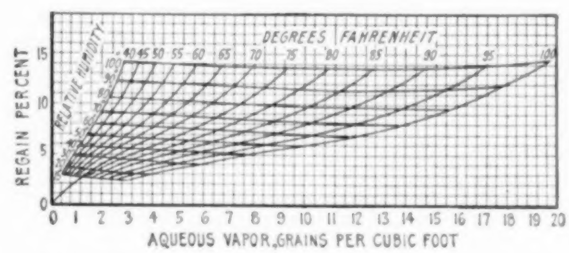


Fig. 4 Isothermal and Relative-Humidity Lines for Cotton

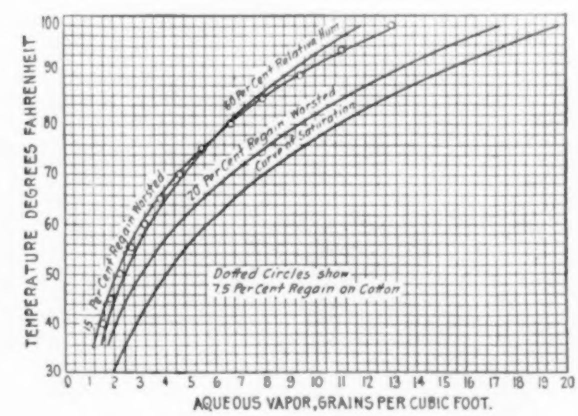


Fig. 5 Regain of Cotton and Worsted

cent relative humidity, 15 per cent regain in worsted, and (to avoid confusion) a number of points only on the curve of 7½ per cent regain in cotton, are represented. An additional regain curve for 20 per cent on worsted is also shown.

It will be noticed that at ordinary mill temperatures the 7½ per cent curve for the cotton here used closely coincides with the 15 per cent worsted curve, and within the limits of observation their deviation is not great at either high or low temperatures. In the absence of other considerations, this fact might be taken therefore as reason sufficient for establishing a 7½ per cent regain for cotton for this country, if it be conceded that 15 per cent is the proper standard for worsted.

It is interesting to note also that the 60 per cent humidity curve, Fig. 5, crosses the combined regain curve, just named, at about 77 deg. fahr., a room condition which, according to Sconfietti, is compatible with both good work and comfort in a cotton-spinning room.

Sconfietti gives his own experience, as corroborating that of other men, that the most favorable temperature for manufacturing cotton (and textile fibers in general?) is between 68 and 77 deg. fahr., while the relative humidity for cotton should be:

In carding, between 50 and 55 per cent
In spinning, between 55 and 60 per cent
In weaving, between 65 and 70 per cent.

These figures would indicate a regain condition for cotton, by the 1911 tables:

In carding, from about 6.5 per cent to 7.2 per cent
In spinning, from about 7.2 per cent to 8.0 per cent
In weaving, from about 8.6 per cent to 9.5 per cent.

or, in other words, for cotton the stock should be *gaining* at each step of manufacture.

Whether this be true or not for cotton, it is not true for worsted so far as the Bradford system of spinning is concerned. For the Bradford system of worsted spinning, even though the stock contains oil, there seems to be no doubt that it must be losing moisture during the process of spinning to make a good spin; hence the necessity, if the top contains only 15 per cent regain, for keeping the moisture condition well up during the processes of drawing and roving or else for long aging in a cool, damp cellar before going to the spinning frame. The latter plan used to be thought an absolute necessity, but modern successes in humidification have very largely obviated it.

One of Schloesing's methods involved the use of pure sulphuric acid of known strengths in obtaining known and comparatively constant states of relative humidity in a closed vessel or chamber.

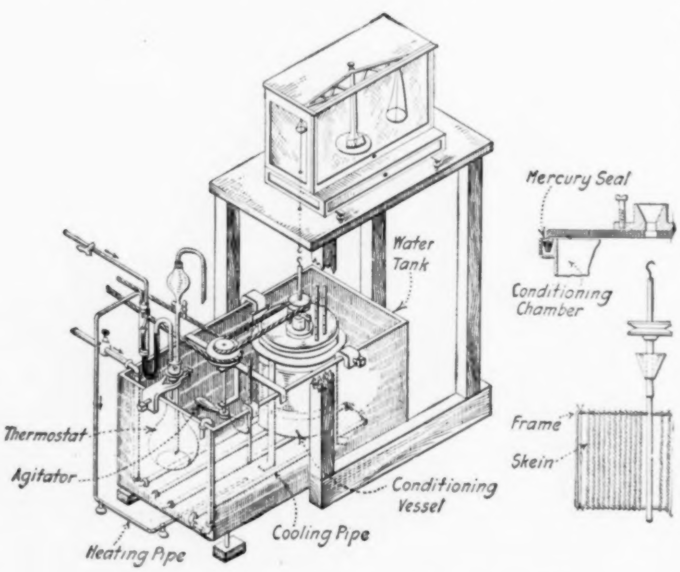


FIG. 6 APPARATUS FOR DETERMINING REGAIN

Both of his methods, though checking up well with each other, involved the question of control and length of time required to arrive at results—a time so great that to apply them over a wide range of temperatures to make a complete comparison with the writer's figures seemed out of the question. The sulphuric-acid method was the simplest but, though making use of conditions of known humidity in obtaining the facts (not the law) of regain, neglected the phenomenon of lag—one of the time elements in the problem.

To accomplish this, it was necessary to obtain the elimination of the lagging effect by direct observations under conditions of constant temperature and constant humidity indefinitely maintained, or so closely known that the constant condition required could be calculated. In attempting this, use was made of Schloesing's sulphuric-acid method in an apparatus developed after much experimenting, shown in Fig. 6, so that observations could be repeated over and over again under conditions calculably alike upon the same and upon different pairs of skeins to obtain a satisfactory average for a given kind of material at as many points of temperature and humidity as desired.

The principle of operation of the apparatus is: A pair of skeins, one moister and the other drier than the proposed humidity would give, are hung on the two ends of a specially designed metal frame within an enclosed metallic vessel, the cover of which is sealed by mercury. Excepting the top, this vessel is entirely surrounded by water, the temperature of which can be kept constant by a thermostat. In the bottom of this chamber, paraffined for protection, varying known strengths of sulphuric acid are placed and the framework revolved in the air above by a small motor, which also turns an agitator in the outside water. Thermometers pass through the lid of the sealed chamber, one terminating in the air and the other in the liquid below, so that the exact temperature of each is known and therefore the exact equilibrium conditions are calculable. The bearing for the shaft is a copper tube held in a conical plug, making a practically air-tight joint. When it is desired to weigh the combination, the driving band is disengaged, and the hook from the scale above inserted in the hook of the shaft of the framework, just lifting it from its conical bearing, so that the weight can be taken accurately.

It will be noted that: *The original dry weights of the skeins having by calculation, from blank tests on other skeins, been made equal, one-half of the sum of the weights found always represents the average present condition of the skins.*

It was soon found that in about an hour's time an equilibrium was established between the two skeins so that there was neither gain nor loss thereafter, while the temperature remained the same.

*It was, however, found on repeating the same experiment on the same pair of skeins, in the same order, that is, the same skein always remaining the drier, that the successive observations gave continually lower results for the average regain;* but if the skeins for a repeated experiment were alternated in the exposing condition, that is, if the one which had been drier in the first instance was made the damper in the second, then the results represented a very nearly constant condition of regain, not only for the same pair of skeins, but for duplicate pairs, and in the final accepted results a series of tests on duplicate samples, alternating for the moist and dry state in each, were averaged for each point of regain determined.

By suitable humidities and temperatures, thus predetermined and accurately controlled, points of regain in sufficient number were found not only to confirm the basis for the general law previously propounded in 1905, but to extend its application so as to cover for both worsted and cotton the relationship of humidity and regain at all temperatures within the limits of the apparatus as arranged, giving reliable results not previously found possible.

Having obtained these accurate comparative points, the mathematical considerations as first announced in 1905 and their further application to the more complete conception of the laws of regain as developed in 1911 may be briefly summarized.

### SUMMARY OF THE LAWS OF REGAIN

To summarize these laws of regain in cotton and worsted, we can say:

*First.* The general law for cotton and worsted, and probably for any other textile fiber, may be expressed by the formula

$$K\ R\ T^{s} = H \times 5771.44 \times 10^{s}$$

in which $H$ represents any given relative humidity expressed

decimally; $R$ the regain at any absolute temperature $T$; $K$ is a variable coefficient depending upon $H$, $R$ and $T$ in such a way that for $H = 1$ the product of $K\ R\ T^3$ is a constant quantity represented by the number $5771.44 \times 10^8$. In this, 5771.44 is the weight in grains of a cubic foot of aqueous vapor at any

*Second.* For any given temperature the relation of values of $R$ to the variable $K$, for both worsted and cotton, is expressed by a hyperbolic equation, differing for each substance.

*Third.* For any other temperatures the law for worsted is: *For the same humidity the squares of the regains at different*

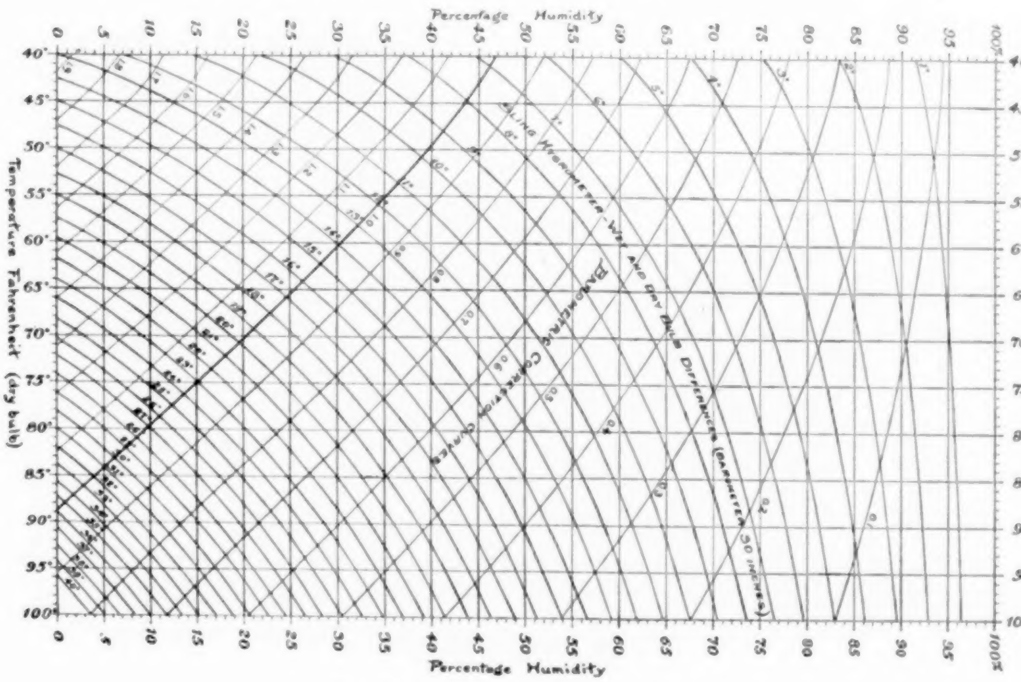


Fig. 7 Barometric-Correction Chart

Note.—Figs 7 to 11, inclusive, are reproduced from the author's original drawings to ensure their accuracy.

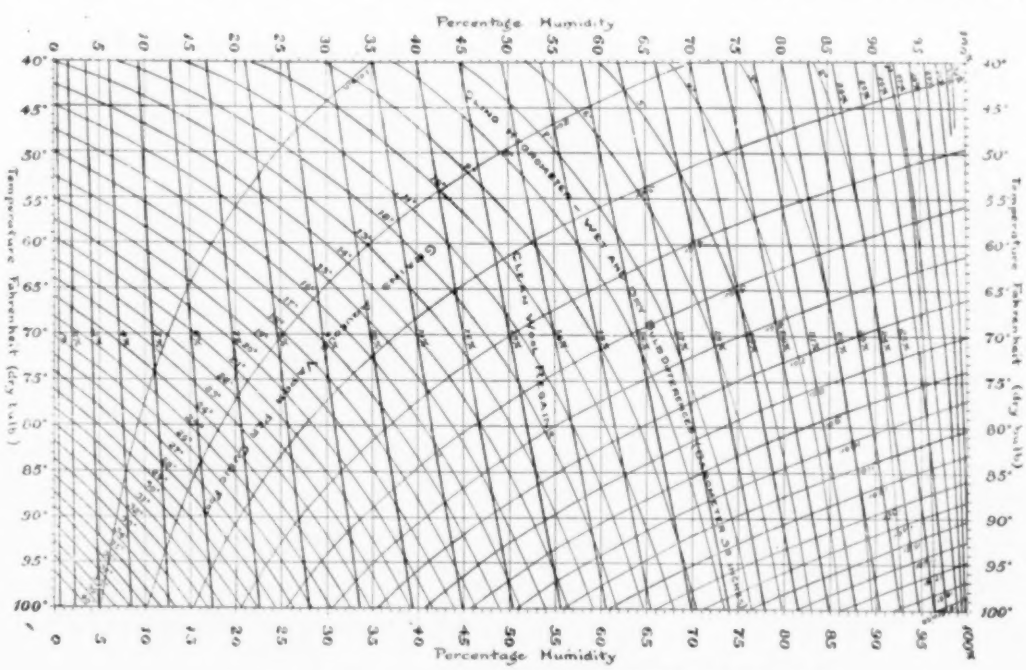


Fig. 8 Absolute- and Relative-Humidity Chart, Wool

temperature multiplied by the corresponding absolute temperature in degrees fahrenheit, divided by the maximum elastic force of aqueous vapor at that temperature, expressed in inches of mercury. In this expression, therefore, we are independent of tables for saturated aqueous vapor, either for unit of weight or elastic force.

*temperatures are to each other inversely as the cubes of the corresponding absolute temperatures.*

***Fourth.*** **The law for cotton is:** ***For the same humidity the first powers of the regains at different temperatures are to each other inversely as the first powers of the corresponding absolute temperatures.***

No other substances have as yet been compared in this manner by the writer, but for such substances it is quite possible that all these relations, except those of the general formula, may be decidedly different.

points of their construction, nor are they adaptable for everyday use. By properly constructed charts on a unit-system basis, it is possible to avoid the necessity for using any tables in either hygrometric observations as such, or the reading of

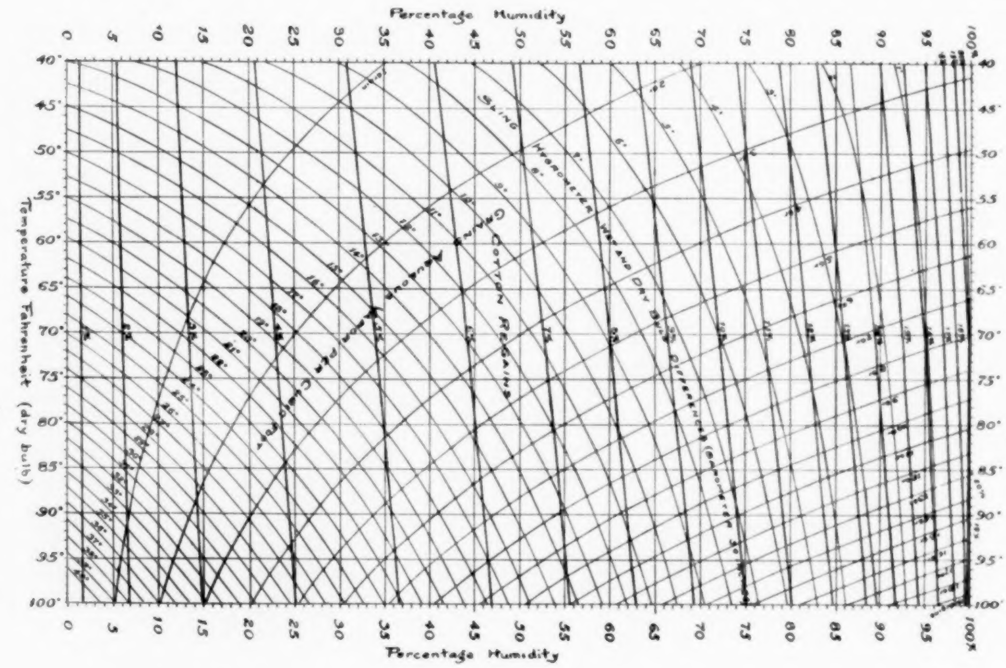


FIG. 9 ABSOLUTE- AND RELATIVE-HUMIDITY CHART, COTTON

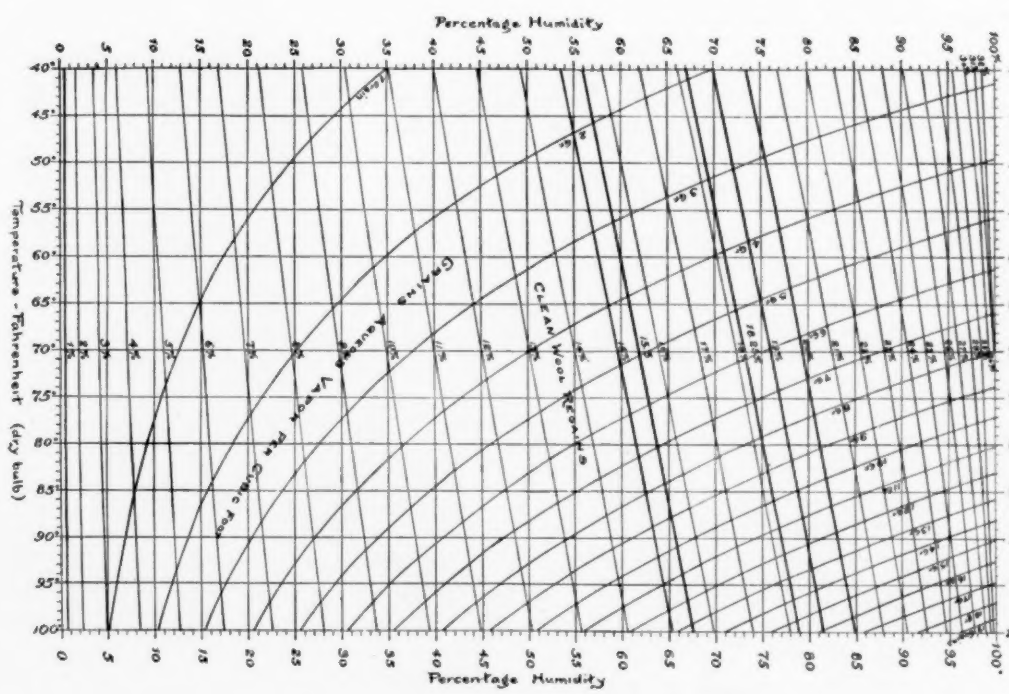


FIG. 10 UNIT-VARIATION REGAIN LINES, WOOL

## ANOTHER METHOD OF CHARTING AND FURTHER DEDUCTIONS EXPLAINED

Though graphically expressing the relations and laws referred to, the charts so far shown do not lend themselves readily to accurate portrayal of the established facts at all the corresponding conditions of equilibrium therewith for the several textile materials.

Figs. 7 to 11 were devised for this purpose, so far as commercial and mill uses require, for wool and cotton. On each of them the vertical lines represent (as labeled) 5-deg. inter-

vals of temperature and the horizontal lines 5 per cent intervals in relative humidity. For closer reading, each degree and each per cent are marked off respectively at the top and bottom and on both sides of the charts.

*Barometric Corrections.* Fig. 7 is needed in ordinary mill use only in a negative sense. It shows the effect of the height of the barometer, by unit variations, in obtaining the correct relative humidity from readings of the sling hygrometer, and can be read as closely as necessary for practical purposes. On respect to the absolute- and relative-humidity lines in whatever manner either may have been determined.

On each of these four figures, the unit-regain curves are nearly straight lines for both clean wool and cotton, running in a general upward direction from left to right, and labeled from 1 to 32 per cent on the wool charts, and from 1 to 20 per cent on the cotton charts.

In Figs. 10 and 11, besides the unit-difference curves, there are three extra lines, two in Fig. 10 and one in Fig. 11,

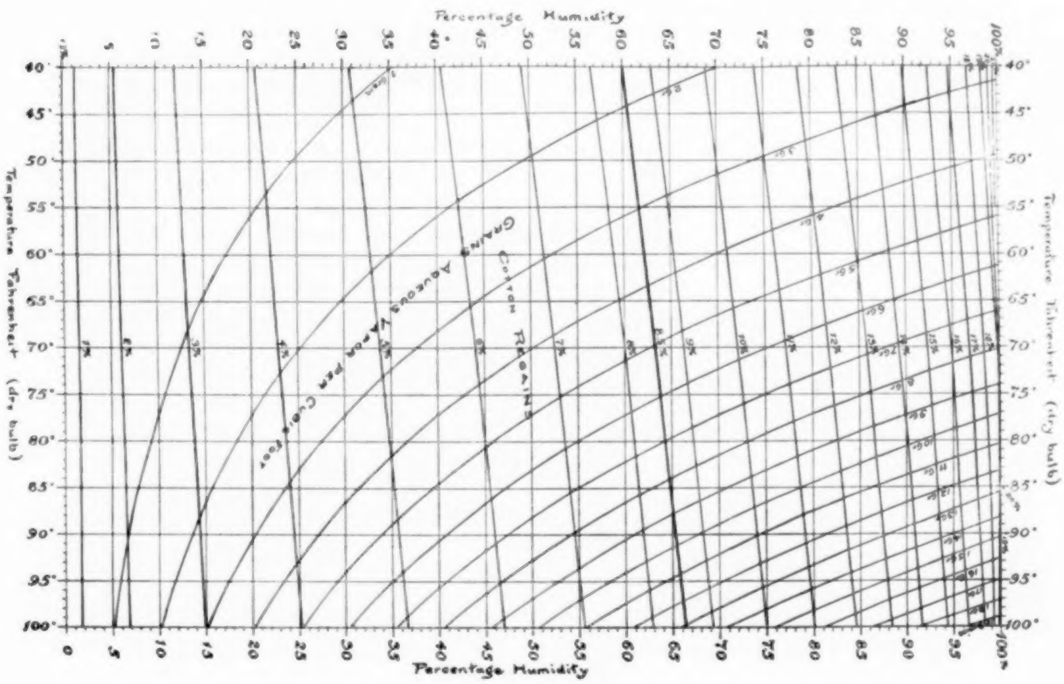


Fig. 11 Unit-Variation Regain Lines, Cotton

it and on Figs. 8 and 9 the curves running in a convex upward direction from left to right and labeled from 1 to 40 deg. downward represent the position of unit differences in the wet-and-dry bulb readings of a sling hygrometer and are plotted from relative humidities, with barometer at 30 in., very carefully calculated to the nearest one-tenth of 1 per cent.

The lines crossing these wet-and-dry-bulb difference curves and running from left to right, concave downward, are designated barometric-correction curves. They are labeled, beginning at the lower left-hand corner, 1.9, 1.8, 1.7, etc., to 1.0, and then continuing 0.9, 0.8, etc. Their significance is this: The correction in per cent to be added to or subtracted from the humidity findings by the chart curves will be one times the drop of the barometer in inches below 30, and one times the rise above 30, respectively, on every reading falling on the line labeled 1.0, and 0.9 times, 0.5 times or 1.1, etc., times such readings falling on the curves so labeled.

For readings ***falling between*** these lines, a relative estimate can be interpolated by inspection, if need be.

*Regain Curves.* Figs. 8 and 9 are intended to be used in determining from sling-hygrometer readings both absolute and relative humidities, within the limits of temperature indicated and the corresponding regains, for a state of equilibrium therewith on wool and cotton respectively.

Figs. 10 and 11 show within the same limits of temperature the unit-variation regain lines for wool and cotton with labeled, respectively, 15.5 per cent, 18.25 per cent and 8.5 per cent. These, with the three emphasized lines at 15, 19 and 20 per cent, represent equilibrium conditions for certain commercial standards in wool and cotton, to be more fully described and explained later.

All these lines are plotted from data developed either directly from the writer's original formulæ, or, where admissible, by interpolation from the tables in the Appendix.

*Absolute-Humidity Curves.* In each of Figs. 8 to 10 are plotted curves running from left to right in a convex direction downward, labeled, respectively, 1 grain, 2 grains, 3 grains, etc., up to 19 grains, which represent weights of aqueous vapor per cubic foot under the temperature and relative humidity conditions indicated at their points of intersection with the temperature and humidity lines. These curves are plotted from data calculated from Professor Marvin's Table 12 in U. S. Weather Bureau Report No. 236.

### ILLUSTRATIONS OF THE PRACTICAL USE OF THE CHARTS

*Example 1.* Assuming a 30-in. barometer, suppose an observation by the sling hygrometer gave a dry-bulb temperature of 65 and wet-bulb 60 deg. Note in Fig. 8 that the 5-deg. difference curve crosses the vertical 65-deg. temperature line just a little below its intersection with the horizontal 75 per cent humidity line; that the curve for 5 grains of aqueous vapor per cu. ft. crosses a little to the left of, and the 19 per

cent regain for clean wool exactly at the same 75 per cent point. The results would be properly recorded:

| | |
|---|---|
| Temperature, deg | 65 |
| Relative humidity, per cent | 75 |
| Absolute humidity, gr. per cu. ft | 5.1 |
| Wool regain, per cent | 19 |
| Cotton regain, per cent | 10.7 (Fig. 9) |

It will be observed that even on the reduced scale of Fig. 9 it would be possible to read the relative humidity closer and call it 74.8 per cent, and the other items correspondingly less; but it would not be worth while to do so for a single observation, because that degree of accuracy would rest upon the assumption that the difference in the wet- and dry-bulb temperature had been taken with an observation error of less than one-tenth of a degree—an improbable supposition, except with a very careful observer using very refined instruments. Mill observations are usually taken to the nearest ½ deg., implying a possible error of over 0.2 deg., or as much as 1 per cent in any single record of humidity, under approximately like conditions.

Again, under like circumstances, referring to Fig. 7, it will be seen that the observed point falls approximately on the barometric-correction curve 0.3, which means that it would require a difference of 3 1/3 in. in the barometer, more or less than 30, to make a difference of 1 per cent in the humidity reading; or, in other words, an amount no greater than the possible error of an ordinary mill observation.

*Example 2.* For dry bulb 77½, wet bulb 61 deg., difference 16½ deg., the point is found at:

| | |
|---|---|
| Temperature, deg | 77½ |
| Relative humidity, per cent | 37½ |
| Absolute humidity, gr. per cu. ft | 3.8 |
| Clean-wool regain, per cent | 10.3 (Fig. 8) |
| Cotton regain, per cent | 5.3 (Fig. 9) |
| Barometric-correction factor | 0.65 (Fig. 7) |

In this case, to need a correction of as much as 1 per cent in the humidity record, involving 0.2 per cent and 0.1 per cent only in the reading for the regain conditions of wool and cotton, respectively, would requiie [since $(1.00 \div 0.65) = 1.54$] a drop in the barometer to below 28½ in. or a rise to above 31½ in.

### OTHER INTERPRETATIONS AND INFERENCES

As regards barometric corrections in mill practice, the humidity conditions usual either for warehouse storage or manufacturing rooms evidently lie above the barometric-correction curve labeled 1.0; and Figs. 8 and 9 show that it requires, for conditions in the neighborhood of this line, a difference of about 5 per cent in relative humidity for wool and 10 per cent for cotton to make as much as 1 per cent difference in their respective regain conditions. Consequently, the probable maximum effect upon humidity readings of any barometric change likely to occur in our latitude and at elevations not exceeding 1,000 ft. would only be equivalent to about one-half of one per cent in the proper reading for the regain of wool and one quarter of 1 per cent for cotton. The common custom, therefore, of paying no attention to barometer readings in observations for moisture conditions in factories not situated at high elevations is quite justifiable from a practical standpoint.

It cannot at present be said that any definite standard for moisture regain on cotton, manufactures of cotton, raw or scoured wool, worsted yarns, or other manufactures of wool except tops, or other textile materials except silk, is properly recognized in the trade in this country.

The most important reason for not adopting the English and Continental standards for wool here lies in the fact that it is more difficult to maintain indoor atmospheric conditions in our climate corresponding to such standards, and, moreover, tops and yarns actually containing such amounts of moisture, if long stored unprotected from mildew, are likely to become seriously damaged.

In the writer's experience there is little such danger of damage at 15½ per cent on wool (15 per cent on oil stock) or 8½ per cent on cotton. While it is true that for the best conditions of spinning it is better to have in the material an amount of moisture equal to, or possibly even greater than, the Bradford standards, in order to allow for necessary losses by evaporation and still maintain a humidity condition of spinning rooms at a point where electrical action in cold weather would be without material effect, yet this can be taken care of by the spinner himself, and need not involve the danger from mildew by long storage at Bradford standards in our warmer climate. However, with material worth anywhere from 50 cents to $2.00 per lb. or more, it is easy to see the commercial importance of knowing at what price 100 lb. of bone-dry material is being bought or sold, but it makes little difference, as a commercial transaction, whether the price be fixed on the basis of that 100 lb. weighing 110 lb., 115 lb., or even 120 lb., providing the standard is accepted, condition determined, and corrected weight billed up.

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The skin which forms on the surface of some oil paints and varnishes is practically airtight. According to a paragraph in the *Zeitschrift des Vereines Deutscher Ingenieure* of July 21, 1917, such a skin, which is, at any rate, waterproof and dustproof, can be formed on sacks of jute and on bags of cardboard, etc., for the transport of lime, chalk, cement and dextine, as well as for packing greasy and oily materials. The process is described as the Plüss-Stauffer process, and it is stated that the skin is pressed upon the material, which need not be a texture, by special machinery.—*Engineering,* September 28, 1917, p. 340.

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Aluminum bronzes can be improved by thermal treatment. When they contain less than 7 per cent of copper, the thermal treatment will not affect the properties much, according to the *Giesserei Zeitung* for June 1, 1917. Higher-grade bronzes can be hardened, however, and by the further addition of iron, silicon and other elements the mechanical properties of the alloys can be much varied. Thus, for instance, bronzes can be prepared having a Brinell hardness of 100 without being brittle. An aluminum bronze, resembling in its mechanical properties a 0.35 carbon Swedish steel, was given hardness values ranging from 100 up to 260 by various thermal treatments; such bronzes will answer as bearing metals even for high speeds. The following figures are given as to the properties of a 10 per cent aluminum bronze containing some titanium, the percentage of which is not stated; the figures refer to the original alloy as cast, to the quenched bronze, and to the bronze after the thermal treatment at different temperatures: Limit of elasticity in kg. per sq. cm., 9.6, 19.8, 27.7 to 19.2; tensile strength in kg. per sq. cm., 51.8, 73.6, 67.7 to 64; elongation in per cent, 19.5, 1.0, 5.5 to 1.4; contraction of area in per cent, 33.7, 0.8, 9 to 18.5; Brinell hardness, 100, 262, 158 to 140.—*Engineering,* September 21, 1917, p. 305.

# LABOR-TURNOVER RECORDS AND THE LABOR PROBLEM

By RICHARD B. GREGG,[1] BOSTON, MASS.

Non-Member

*The application of rational methods of analysis to the conduct of the operative details of industrial establishments has long been accepted as an effective means of approaching the maximum efficiency of output, and in recent years production problems of all kinds have been studied and solved by such methods. In this paper the author advocates the application of a similar mode of analysis to an increasingly important phase of the labor problem, namely, the labor turnover, or the shifting of workers from one place of employment to another. He considers various causes that have given rise to the problem and suggests other aspects of the subject that still remain to be explored, leaving a discussion of the remedies which have proved successful for future treatment.*

THE study of labor turnover is the measurement of the movement of industrial workers in and out of their employment, and the analysis of its causes and results. The value of such study is patent to everyone who has ever handled employment. The difficulty of training a continually shifting force, the low quality and quantity of production obtainable from tramp workers, the lack of team play, low standards, poor tone, discontent and unrest in an establishment where the labor turnover is high—all these are factors that gravely affect both the annual balance and the ease and effectiveness of management.

There is, of course, a certain amount of labor turnover which is unavoidable and normal. The factory will always be losing people from old age, death not caused by industrial accident or occupational disease, marriage, changes of residence or domestic events wholly uninfluenced by the character of work or pay. What this normal amount will be will vary from factory to factory according to local conditions. A careful estimate in one instance placed it at 21 per cent of the total working force. The amount of turnover in excess of this normal, excepting lay-offs due to slackening demand for product, may be considered a kind of barometer of dissatisfaction, either of employer with employee or of employee with position. The quittings are in effect a sort of gradual continuous strike.

Let us imagine a factory where there is a high labor turnover, with all its consequent difficulties. What would it mean to apply scientific methods to this problem, and what would be the probable results? First of all, we must get the facts. How great is the labor turnover? To get this we must examine the payroll or keep a record of the hirings and quittings and discharges from the entire factory for a given period of time—say a year. By comparing the total number of "leavers" for all reasons with the total normal number of workers in the factory we may obtain the turnover in terms of precentage, which is useful for comparisons with other periods or other groups of workers. For purposes of thorough analysis it will be well to obtain the amount and percentage of turnover for each department and each position with the departments. In one factory the annual turnover for the entire concern for several successive years was in the region of 45 per cent. Again, in one department in a cotton mill the turnover last year was over 500 per cent. The turnover in some positions will occasionally run much higher than that.

Having obtained the annual turnover *in toto* and in detail in this fashion, we will get further light on the situation by working out the turnover for each week and for other divisions of the year such as each of the thirteen four-week periods. In this way we learn whether there are any seasonal or periodic fluctuations. In some industries, such as the building trades or the manufacture of clothing, such variations are very marked.

It is obvious that these measurements and analyses tend to make it more possible to learn the causes for the turnover. Once we learn real causes and definitely locate responsibilities we are in a position to begin to control the phenomenon.

Carrying out our analysis and arrangement of facts still further, we can often obtain very valuable indices of the reasons for high labor turover. For instance, grouping the leavers according to their actual earnings will show the significance of the wage factor as a cause for leaving. To illustrate how this works out: A certain cotton mill learned that there was a high labor turnover in its power department. Upon further analysis the turnover was found to be confined almost entirely to the coal handlers. Inquiry showed that these men were receiving fifty cents a week less than the coal handlers at the local railroad station. The wage was raised fifty cents, the turnover ceased, and the management was relieved of its worry about demurrage charges. Usually a large part of the shifting will be found in the low-paid groups. The results of most experiments with this fact seem to show that low wages are much more the cause of the high turnover than any inherent and unchangeable characteristics of that group of workers.

Other groupings that might prove significant are sex, nationality, age, foremen, rooms, heaviness of work, amount of illumination or ventilation of work place, dirtiness of job, method of pay, amount of accident risk, anxiety, amount of other fatigue factors, distance of workers' homes, etc.

A further aid in learning the causes for leaving is making inquiries from the leavers before they go and from the foremen.

As a result of all this recording of facts, measuring, weighing, testing, analysis and classification, we find ourselves able to determine the real causes for the turnover in a large number of cases. Sometimes the causes will be simple, as in the case of a motor company that learned that most of its leavers had resided a considerable distance away from the plant. By giving preference to applicants living nearby the turnover was grad-

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ually very greatly reduced. Usually, however, there is a complex set of causes, and the apparent cause merely serves to release discontent that has gradually been accumulating for a number of reasons. With patience and skill we can usually arrive near to the truth. By further measurement and analysis we can determine, or at least approximate, the cost of losing a worker in a particular position and training another. These costs may be roughly divided into overhead costs and operating costs.

Among the overhead costs there are:

1 More rapid depreciation of machinery because of ignorance or lack of skill of new workers
2 Extra floor space and extra machines to provide against idleness of a certain amount of machinery due to shifting labor.

Operating costs may include any or all of the following:

1 Time of increased superintendence or office work:
  - *a* Time spent by foremen or superintendent in discharging a workman where that is the way the vacancy occurred
  - *b* Time spent by foremen or other workers in training the new employee
  - *c* Time spent by clerks on additional payroll or other records.
2 Machine costs, covering
  - *a* Time machinery is idle when a new worker cannot be obtained immediately
  - *b* Idle machinery for temporary stoppages due to ignorance or lack of skill of new worker
  - *c* Repairs to machines or renewals of tools broken for the same reason.
3 Material costs, including
  - *a* Waste or damaged material due to ignorance or lack of skill of new worker
  - *b* Difficulties in subsequent processes due to poor work by new employees in previous processes
  - *c* Lower production while new employee is working up his best skill.
4 Additional accident cost due to higher rate of accidents among new employees.

These two kinds of overhead costs and four groups of operating costs, while not exhaustive, serve to illustrate the method of observation, recording, measurement and analysis which is just as helpful in this aspect of the matter as elsewhere. With knowledge so obtained the factory manager is in a position to estimate more truly the importance of this problem and to judge whether he can afford to take certain steps to reduce this turnover.

As is probably well known, those who have made the most careful studies of this question find that it costs about $10 to replace an ordinary laborer, and as much as $300, and perhaps more, to replace skilled workers. The cost varies, of course, with the nature of the position. The total losses are unquestionably enormous. Mr. Magnus Alexander in his well-known study, it may be remembered, estimated the losses in a group of twelve metal-working factories in a single year at not less than $831,000; and one textile mill, employing about two thousand workers, may be mentioned which is losing at least $20,000 annually from its high labor turnover. Other instances could be multiplied.

It should be remembered, moreover, that none of these estimates includes the losses to the employees or the community. What frequent job shifting means to the employee and his family in terms of frequent house moving, ill-feeling, discouragement, bitterness, decrease of skill, lowering of pride and self-respect, we have no means of measuring.

There are many other aspects of the matter that still remain to be explored. What are the relations between absences and tardiness and labor turnover? Cannot absences and tardiness be studied in the same way as labor turnover? What are to be the relations of labor-turnover control to such problems as trade education, promotion policies, the intellectual life of the industrial community, the mobility of labor, scientific management, women in industry? Will it be wiser to leave the broad problem of control of labor turnover entirely in the hands of employers, or should the state have a voice in the control? These are questions both of the present and of the future. In thinking about them and working over them it is important to bear in mind the value of scientific method. The discovery of a unit of measurement, a method of measurement, analysis and classification, has made possible great advances in this one small part of the labor problem.

Let us get the facts in the labor situation,—all of them. Just as Darwin always recorded all facts which tended to contradict his hypotheses, because he knew that unless he did so he would be apt to overlook those facts in order to make his hypotheses triumph, let us also recognize the presence of personal and business interests and bias in ourselves as well as in others. Let us never dodge or shirk the facts. Let us record them so that we and others can study them at any time. Let us measure when means of measurement are obtainable. Let us analyze, weigh, test, and fearlessly experiment. Let us invoke our finest constructive imagination in making our hypotheses. Let us not be dogmatic but humble with our theories, ready to throw them away when new facts are recognized.

Let us last of all never overlook the human instincts. They lie at the heart of our problem. Because of much past neglect in the handling of this question they require the greater emphasis.

It is unquestionably a trait that every person wants to have some sort of control of the circumstances and direction of his own life and of his work as a part of his life. For this reason I believe not only in scientific method and spirit, but I also believe that science must join hands with democracy in order to reach any sound solution of the greatest of all our problems. To find the methods and forms of organization through which such a solution may be obtained is the task that lies ahead of us.

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Like the farmer, the engineer is an indispensable factor in the well-being of the nation. He has to deal not with whim and fancy, but with the forces and elements of nature. At bottom his problems involve the utilization and conservation of the natural resources of the nation—the patrimony, as it were, of nature to man. With progress social life becomes increasingly complex. With division of labor comes the efficiency and expertness of the specialist, but also the interdependence of individuals and communities. Only the uncivilized who live upon the gifts of nature are today self-sufficient and independent as regards the necessities of existence. A large city, on the other hand, is always within hailing distance of starvation. The engineer is a product of this interdependent life, and his sway has increased as civilization has grown in complexity. His function has become so specialized that it cannot be dispensed with, and none can substitute in his place. Light, heat, power, sanitation, irrigation, construction, intercommunication—these are vital elements in modern progress. —*Power,* October 23, 1917.

# ACCIDENT PREVENTION IN THE TEXTILE INDUSTRY

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Non-Member

*Mechanical accidents form a large percentage of all those occurring in the textile industry. Contributory factors to this condition are (1) an exceptionally large mechanical exposure—the exposure points run into the thousands or tens of thousands for a single plant and it is an extensive problem to guard completely all the belts and gears, (2) female and child labor—a large percentage of the employees are women and youths, and (3) an ever-present temptation to clean machines in motion—there is a natural tendency on the part of the operator to be constantly cleaning or picking the "fly" out of a machine.*

*There is probably no other industry where so great a weight should be given to mechanical guarding, or where effective guards will produce such important results.*

*This paper describes the various methods and forms of mechanical protection which are desirable for textile machinery, discusses effective steps toward overcoming difficulties encountered in providing complete safeguards, and codifies definite standards for use in specifying guards for textile machinery.*

THE manager of the steel mill handling several hundred tons of molten metal every day, might think that in comparison with his difficulties the mechanical problem involved in turning out a spool of thread or a bale of cloth would be very simple. A study of conditions in the textile industry, however, would soon convince him that the man in charge of a modern textile plant has some problems which are all his own. Many of these problems come from conditions which have a very direct bearing on accident prevention, notably the following:

*Mechanical Exposure.* In the majority of manufacturing industries the number of machines is less than the number of employees. For example, the combined insurance records from a number of states show the following average conditions:

Earthenware manufacturing, 17 machines per hundred employees.
Furniture manufacturing, 40 machines per hundred employees.
Rubber goods manufacturing, 60 machines per hundred employees.
Printing, 67 machines per hundred employees.

In the textile industry, on the other hand, the number of machines usually exceeds, by several times, the number of employees. Sixty-one characteristic cotton mills contained 33,393 employees and 119,078 machines, or,

Cotton mills....................357 machines per hundred employees

The average cotton mill in Massachusetts has nearly a thousand employees and several thousand machines. These machines are usually belt-driven, and some of them have auxiliary belts in addition to the main driving belt. Most of them have gears at several points on each machine. The exposure points run into the thousands or tens of thousands for a single plant, and it is an extensive problem to guard completely all the belts and gears.

| District | Males 16 years and over | | Females 16 years and over | | Children under 16 years | |
|---|---|---|---|---|---|---|
| | Number | Per cent | Number | Per cent | Number | Per cent |
| New England States.... | 76,483 | 49.0 | 70,113 | 45.0 | 9,385 | 6.0 |
| Middle States.......... | 13,852 | 43.7 | 15,116 | 47.6 | 2,765 | 8.7 |
| Southern States......... | 54,577 | 45.5 | 37,885 | 31.6 | 27,538 | 22.9 |
| Indiana and Other States | 806 | 29.4 | 1,597 | 58.3 | 341 | 12.3 |
| Total.............. | 145,718 | 46.9 | 124,711 | 40.2 | 40,029 | 12.9 |

*Kind of Employees.* Another feature of the textile industry that adds to the accident hazard is the fact that such a large percentage of the employees are women and youths, as shown by the data in the preceding table from one of the U. S. Government publications.[1]

These figures were for 1905, and it is probable that the number of young persons employed in the cotton mills has been reduced by child-labor laws enacted since that date. It is undoubtedly safe to assume, however, that at least half of the employees in cotton mills are women and children.

Women are naturally less mechanically inclined than men and are not so likely to appreciate the danger of power-driven machinery. Their clothing and hair are much more likely to become entangled in machinery, thus making the hazard inherently greater for women than for men. The youthful employee is also more likely to be injured through carelessness and as the result of chance-taking or horseplay.

A large percentage of cotton-mill employees are foreigners, to whom it is difficult to explain fully the hazards of their work. Figures from the government report mentioned show that less than 10 per cent of the employees are American or American-born.

*Cleaning Machinery.* Another condition contributing to the accident hazard in the textile industry is the fine lint or fluff which results from many operations, and which tends to collect in the form of "fly" over the machinery and gets into the gears and moving parts. While this is not likely to injure the machinery, it brings about a natural tendency on the part of the operator to be constantly cleaning or picking the "fly" out of the machine.

Most plants have rules that the machinery shall not be cleaned while in operation, but they are difficult to enforce. Out of a total of 557 mechanical accidents reported by cotton mills to one insurance company, 88 (or about 16 per cent) occurred from cleaning while machinery was in motion. The

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[1] Report of Conditions of Women and Child Wage Earners in the United States.

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tendency to do this is enhanced by the fact that the operators are usually paid on a piece-work basis, hence they do not like to lose any product by having the machines shut down for cleaning.

Thus we have the combination of (1) an exceptionally large mechanical exposure, (2) female and child labor, much of which is non-English-speaking, and (3) an ever-present temptation to clean machines while in motion. Under these circumstances it is not surprising that mechanical accidents form a large percentage of all accidents occurring in the textile industry. That this is actually the case is corroborated by an analysis of accidents in Massachusetts, a state which has approximately one-third of all workmen employed in cotton mills in this country. While mechanical accidents for all industries of the state were only 27 per cent, numerically, of the total number of accidents reported, mechanical accidents in cotton mills were 44 per cent of the total for this industry, or nearly double the average ratio for the other industries.

FIG. 1 GUARDS FOR PICKERS

These photographs show an excellent arrangement of guards for belts and chains on pickers. The guards are supported by rods fastened to the framework of the machine, and can be quickly removed by loosening a couple of thumbscrews which secure them to the supports. This permits cleaning the floor underneath the guards without disturbing them, as would be necessary if the guards were supported from the floor. In order to avoid places where "fly" may collect, the guards do not completely enclose the belts and chains, but a transverse section has been placed across each guard, between the two sides of the belt or chain, to prevent danger of a hand being slipped down inside the guard and thus being caught and injured. The projecting end of the beater shaft is protected by a metal cap.

An additional study of accidents in the thirteen principal industries of Massachusetts, such as boots and shoes, metal-working, electrical supplies, rubber factories, paper mills, and printing establishments, shows that the lost time per thousand employees resulting from the mechanical hazards of belting, shafting and gearing is three times as great in the cotton mills as the average for the whole thirteen industries.

Mechanical accidents as a class are more serious than non-mechanical accidents.[1] While they represent a little less than one-half of all accidents reported in the cotton industry in Massachusetts, it is probable that they are at least three-quarters of the problem from the standpoint of severity.

While safety education of employees through the organization of safety committees, safety talks, the posting of safety bulletins and signs, etc., are important in this industry, as in all others, there is probably no other industry where so great weight should be given to mechanical guarding, or where effective guards will produce such important results, as in the textile industry.

### INTERLOCKING GUARDS

The effort to reduce the mechanical accidents in this industry has resulted in the development of a type of guard which is about as nearly "fool-proof" as any mechanical device can be, —the so-called interlocking guard. In this form of protection the guard is so arranged that it cannot be removed while the machine is running, and the machine cannot be started until the guard is in place.

This result can often be secured by a very simple and inexpensive arrangement; for example, the beater lock shown in Fig. 2. The beater revolves at high speed and the loss of hands and other serious injuries have resulted from employees putting their hands into it while it is running. To prevent such occurrences a disk is keyed to the beater shaft so that it revolves whenever the beater is in motion. Before the beater cover can be raised a projection on the locking arm used to keep the beater cover closed must be slipped through an opening in the disk. This can only be done while the disk and shaft are at a standstill, and so long as the locking arm is in contact with the disk it prevents the machine being started, which means that the cover must be replaced and the locking arm slipped back over it before the machine can be started up. Similar devices are also applied to various kinds of gear covers.

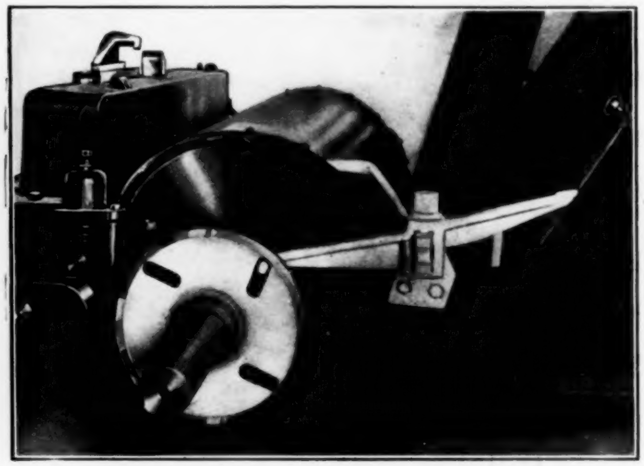

FIG. 2 INTERLOCKING DEVICE FOR BEATER COVER AND DOOR OVER DIRT GRID (PAT.)

In order to open the beater bonnet or the door, a projection on the locking lever (shown in white) must be slipped through the disk on the beater shaft. Obviously this can only be done while the machine is at a standstill. In order to start up the machine again, the locking lever must be slipped out of engagement with the disk, which insures the bonnet and door being closed before the machine is started.

The general application of this principle to textile machinery would eliminate many of the accidents which now occur on account of carelessness or thoughtlessness of the employees.

[1] See paper by the author presented at the 4th Annual Meeting of the International Association of Industrial Accident Boards, and reprinted in the Weekly Underwriter for September 13, 1917. In one state which kept a separate cost record for these classes, the average mechanical accident cost nearly twice as much as the average non-mechanical accident.

WHEN IS A GEAR GUARD NOT A GUARD?

This is a question that has been agitating safety inspectors and plant managers ever since the first gear guard was built. There is a natural desire on the part of everyone to make guards as simple and inexpensive as possible. Unfortunately, this perfectly legitimate desire has resulted in two types of guards for gears which are so ineffective that they have tended to discredit guarding to a certain extent, because accidents still occur after the so-called guards are installed. One is a band over the face of the gear following more or less closely the outline of the gear, but leaving the most dangerous part, the mesh point, exposed sufficiently to admit a finger or even a hand. Another is to provide a guard which protects the mesh point, but which is not carried around the periphery of the gear, and thus forms a shearing action between the teeth of the gear and the edge of the guard at the point where the teeth pass underneath the guard.

Many of the pioneer concerns in the safety movement, such as the United States Steel Corporation, started out by installing gear guards of the above types; but found that they did not eliminate the accidents and later changed them to guards completely enclosing the gears. There are many partial gear guards in the textile industry today, and they sometimes contribute to accident occurrence from the false sense of security they inspire.

An analysis of 550 textile-machine accidents reported consecutively to an insurance company showed that 88 of these

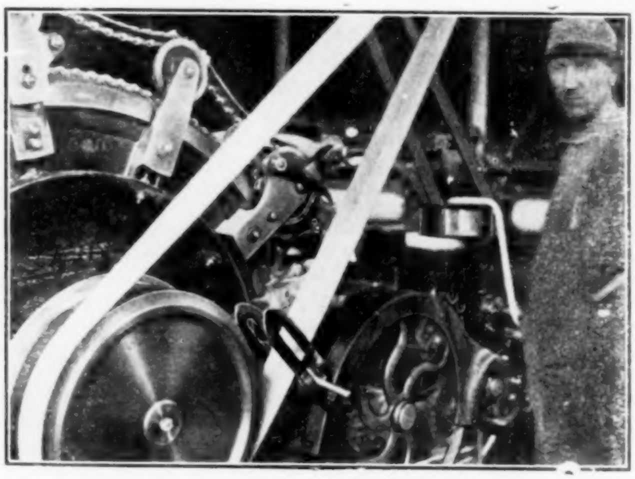

Fig. 3 Belt Shifter for Cards

This shifter can be installed by simply securing it to the circular flange above the pulley by means of one or two set screws. It only requires a few seconds to loosen these set screws and slip off the shifter when it is necessary to reverse the belt for grinding.

accidents, or about 16 per cent, were from gearing; more than a third of the gear accidents were due to cleaning the machinery while in motion.

It is not practicable to apply the interlocking principle to all gearing on textile machinery, but it is practicable to fully enclose the gears; and where the guards are not interlocked they should be firmly fixed in position by cap bolts or other means that make it difficult for the operatives to remove them quickly, and tend to restrict their removal to properly authorized mechanics.

From a list of Massachusetts accidents, out of a total of 1087 gear accidents occurring in one year the cotton mills contributed 400; in addition, the woolen and worsted mills had 236. Thus we see that cotton and woolen mills were responsible for considerably more than half the total number, although they only employed about one-quarter of the workmen engaged in manufacturing industries in the state.

BELT GUARDS

There were 254 accidents from belting in Massachusetts cotton mills during one year and 113 accidents in woolen mills, or a total of 367 for the two industries; this shows that belt guards are also important for textile machinery.

A good many textile machines, such as roving, spinning and twisting frames, have an outboard bearing, supported by a framework around the pulley, that tends to keep employees away from the pulley and offers a certain degree of protection. In addition, these machines are commonly provided with belt shifters, and where the shifter comes down close to the point of contact between the belt and pulley it considerably reduces the chance of anyone being caught at this point, where most of the serious belt accidents occur.

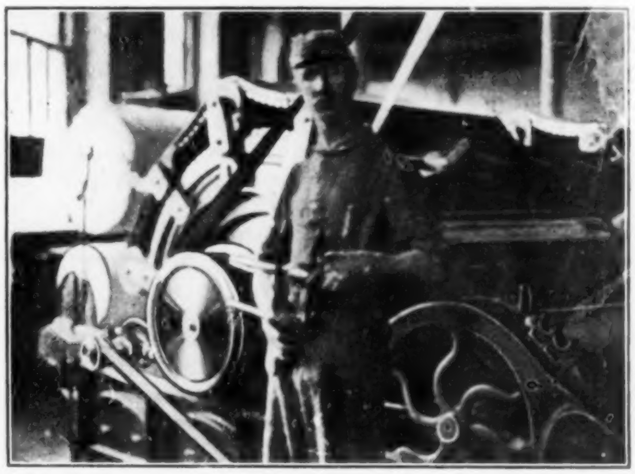

Fig. 4 Belt Guard on Spooler

This shows a belt guard which has been developed by one of the machinery builders. This is a simple and inexpensive type of guard, but taken in conjunction with the outboard bearing and belt shifter it gives quite a good degree of protection.

Several manufacturers of these machines have provided an excellent guard, consisting merely of a semi-circular disk casting or plate which is fastened to the outboard bearing of the machine. This guard only extends a few inches above the contact point between the belt and pulley, and does not guard the upper part of the belt to the height which is commonly prescribed in insurance and other mechanical standards for safeguards.

For other types of machines it is usually impossible for the machinery manufacturer to provide belt guards as an integral part of the machine, on account of the fact that the driving belts lead off at various angles which can only be determined by the local arrangement of each plant. Under such conditions it is necessary for the belt guards to be installed at the plant, after the machinery is in place.

BELT SHIFTERS

Some types of textile machinery, such as roving and spinning frames, have long been equipped with belt shifters as an operating necessity, since the operators need to shut down the machines at some distance from the driving belt.

Other machines, such as cards, are commonly found with-

out shifters. There has been a notion generally prevalent among mill owners that it was impracticable to apply belt shifters to cards on account of the grinding operation, which requires the belt to be reversed. Shifters which are thoroughly practical in operation have been developed, however, and cards, as well as other textile machines, should be so equipped.

### OTHER SAFETY PROVISIONS

Various additional forms of mechanical protection are desirable for textile machinery, such as the elimination of all protruding set screws, keys, bolts or other dangerous projections from revolving parts, and the guarding of projecting shaft ends. Crushing or shearing actions in some machines, such as mule spinning frames, should be protected, as should also rope drives on mule frames.

Many eye injuries have been caused by shuttles flying from looms, and shuttle guards are accordingly important for weaving equipment.

Steam-heated drums or cylinders of slashers, calenders, etc., should be provided with relief valves, and the use of a reducing valve with pressure gage and safety valve on the low-pressure side of the line is an important item of safety equipment for the steam line supplying auxiliaries of this kind.

There were 1776 accidents in one year in Massachusetts caused by machinery peculiar to the cotton mills, and 903 by machinery peculiar to the woolen and worsted mills.

### GUARDING EXISTING EQUIPMENT

Many machines in each textile plant are usually duplicates of one another, so that the pattern for one guard may apply to several hundred machines. Where the guards are made by the manufacturer and the expense of designing guards and making patterns, etc., can thus be distributed over a number of mills, the cost can be reduced to about the lowest possible minimum.

In spite of this condition, however, when we take into consideration the fact that several thousand guards may be required to fully protect the machinery in a single plant, it is evident that the guarding of existing machinery must necessarily be carried along gradually so as to distribute the labor and expense over a period of years.

### GUARDING NEW EQUIPMENT

New machinery is constantly being installed, however, and at the present time much of this machinery is going in an unguarded or partially guarded state, even though the machine builders have developed simple and effective guards for most of the dangerous machinery, and will furnish these guards for new equipment at little or no increased cost. This is an inefficient way of handling the matter, as it is often difficult for the mills to design satisfactory guards after the machinery has been installed, and the cost of the latter method is considerably greater. Worst of all from the safety standpoint, workmen are likely to be injured on the unguarded machinery before it can be protected.

Probably the installation of unguarded machines is due more than anything else to the lack of definite safety standards in this country for textile machinery. As matters stand at present the different textile plants have little opportunity to find out what are effective and practical guards which they could use in ordering new machinery. The machinery builder is also in a quandary, on account of the varying requirements of different states and of different plants. If one builder attempts to furnish complete safeguards for his equipment he is likely to be underbid by a competitor who economizes on cost by omitting the guards.

### SAFETY STANDARDS FOR TEXTILE MACHINERY

Probably the most effective step toward overcoming these difficulties would be the preparation of definite and authoritative safety standards which could be used by the factory manager in ordering new equipment and by the builder in designing his machinery. If such standards were prepared and given wide, general publicity they would undoubtedly be followed for most of the future installations.

It would seem that this might be an excellent line of effort for the Sub-Committee on Protection of Industrial Workers of the Society, or for a special committee which might be appointed. The textile section of the National Safety Council at its annual Congress in New York, 1917, went on record in favor of such standards, and voted to appoint a committee which would coöperate with any others interested in drawing up safety standards for the textile industry.

Much work in the way of developing satisfactory safety devices for textile machinery has already been done, and provisions such as the following, each one of which has been put into practical use by one or more plants, might well be included in these standards:

#### General Standards for All Textile Machines

1. All gears and sprockets exposed to contact shall be completely enclosed, or have a band guard around the face of the gear or sprocket with side flanges extending inward beyond root of teeth, of such design and arrangement that a finger, cannot project through, over, around or underneath the guard and be caught in mesh point of gears or contact point of chain and sprocket.

2. All dangerous projections on revolving shafting such as protruding set screws, keys, bolts and couplings, shall be made flush with the surface or effectively guarded in such a manner as will prevent their catching clothing of persons which may come in contact with them. Projecting ends of beater shafts shall be encased or otherwise effectively guarded.

3. Driving belts shall be equipped with mechanical shifters.

#### Additional Standards for Certain Textile Machines

*Pickers.* All beater covers and doors which can be reached while the machine is running, shall be equipped with interlocking devices which prevent their being opened while the machine is in operation and the machine being started while the covers are in place.

*Cards.* Cylinder covers or doors shall be equipped with interlocking devices which prevent their being opened while the machine is in operation and the machine being started until the covers are in place.

*Lap Machines and Doublers.* These machines shall be provided with interlocking guards which will prevent the operator from coming in contact with the in-running rolls while they are in motion.

*Drawing, Winding, Ring Spinning and Twisting Frames, Etc.* Covers or doors giving access to head end gearing of these machines shall be equipped with interlocking devices which prevent their being opened while the machine is in operation or the machine being started until the covers are in place. A guard shall be placed in front of the driving pulley which will effectively guard the point of contact between the belt and pulley.[1]

*Looms.* Looms shall be provided with effective shuttle guards.

There can be no disagreement as to the desirability of accident prevention from the humanitarian standpoint; from the business standpoint, however, it takes on a new aspect when we realize its effectiveness in reducing an important item of manufacturing cost. Accident prevention then becomes of vital interest.

[1] Belt guards should also be provided for other machines, but they can usually be furnished more advantageously by the purchaser than by the machinery builder.

# BAGASSE AS A SOURCE OF FUEL

By E. C. FREELAND,[1] BATON ROUGE, LA.

Non-Member

THE use of bagasse, or megasse, as it is sometimes called, as a source of fuel, dates from the earliest periods of cane-sugar manufacture. Even before vacuum pans came into use, the sugar manufacturer was wont to burn the sun-dried, or even the green, bagasse under the open kettles. When steam was introduced into the sugar factory as a means of heating the cane juice and syrup, bagasse came to be burned under the boilers as a result. The first boilers designed for bagasse burning differed very little from the coal-burning boilers at that time. As more modern improvements were introduced into cane-sugar manufacture, the methods of burning bagasse were also improved upon, so that, at the present time, very efficient bagasse-burning installations have been perfected. A few of these will be described in a subsequent portion of this paper.

***The heating value of one pound of [illegible] dry Louisiana bagasse has been found by [illegible] ment to be 8300 B.t.u., and despite a high moisture content of about 50 per cent, it is therefore a valuable fuel. While in former years not much attention was paid to the drying of bagasse before burning it, many authorities now claim that a great saving can be effected by such a procedure. The calorific value of this important fuel to the sugar industry, as influenced by the high moisture content, and the benefits of preliminary drying are discussed at length, various methods of calculating the fuel value being given, together with notes on devices employed by various sugar houses in its use for steaming purposes.***

Some of the questions one might ask, when seeking information about this particular fuel, are: Of what value is bagasse as a fuel? How does it compare with coal or oil? What is its composition? It may be well to discuss a few of these points.

Bagasse, chemically, consists mainly of a tough fiber, sugar or sucrose, glucose and other reducing sugars (by a reducing sugar is meant one that will reduce Fehling's solution), and water. The fiber content ranges from 30 to 50 per cent; the sucrose from an almost negligible quantity to as high as 10 per cent; and the water from 40 to 65 per cent; the other constituents occur in such small amounts that they may be disregarded. Its composition varies greatly, according to the method and effectiveness of milling the cane; good milling resulting in a bagasse very suitable for burning, or low sugar and water content. In Louisiana the fiber content averages about 40 per cent and the moisture about 53 per cent; the remaining 7 per cent being mainly sucrose.

### METHODS OF CALCULATING THE FUEL VALUE OF BAGASSE

There are several methods in use for calculating the fuel value of bagasse. In this country Prof. E. W. Kerr's formula is in general use. According to one of his bulletins, the fuel value of one pound of bagasse is calculated as follows:

The heat value of one pound of dry bagasse, by experiment, is 8300 B.t.u. Assume that the moisture content of a bagasse is 48 per cent, and that this bagasse is burned in a furnace the stack temperature of which is 500 deg. fahr. One hundred per cent minus 48 equals 52 per cent dry matter in bagasse. Fifty-two per cent multiplied by 8300 equals 4316 B.t.u. in the dry bagasse. Assume the temperature of the bagasse as 80 deg. fahr. Then the water in the bagasse will have to be raised from 80 deg. up to its boiling point (212 deg. fahr.), and then vaporized before the bagasse can be completely burned. The calculations for the heat necessary to vaporize this water are as follows:

212 deg. — 80 deg. = 132 deg.; 500 deg. — 212 deg. = 288 deg.

Heat necessary to raise the water in 1 lb. of bagasse to the boiling point = 0.48 × 1 × 132 = [illegible] B.t.u.

Heat necessary to vapor[illegible] bagasse from a temperature of 212 deg. = 0 [illegible] B.t.u.

Heat necessary to [illegible] to 500 deg. = 0.48 × 1 × 288 × 0.5 = [illegible] the specific heat of superheated [illegible]

Heat lost [illegible] 598.1 B.t.u.

Net heating [illegible] = 4316 [illegible] 3717.9 B.t.u.

[illegible] the noted [illegible] cane-sugar manu[illegible] introduced the fol[illegible] formula for calculating [illegible] value of bagasse, according to its composition:

[illegible] value in B.t.u. of 1 lb. bagasse = (8550 × per cent fiber) + (7119 × per cent sucrose) + (6750 × per cent glucose) — (972 × per cent water)

The results obtained by using this formula compare very well with the results obtained by burning the fuel in a calorimeter. The one point in favor of using Professor Kerr's formula is that it does not require a complete chemical analysis of the bagasse, while in using the latter a complete analysis is absolutely necessary.

It has been found that the average Louisiana bagasse has a calorific value of about 8300 B.t.u. per pound of dry bagasse and from 3620 B.t.u. gross (with bagasse containing 56.7 per cent moisture) to 4800 B.t.u. gross (containing 42.8 per cent moisture). The net heating values are respectively 2200 and 3350 B.t.u. It is thus seen that the heating value per pound ranges between wide limits, according to the moisture content. In all of the above, 5 per cent was allowed for radiation and no excess air present. The calorific value of Cuban bagasse approaches that of Louisiana very closely for a given moisture content, but for a given per cent extraction on weight of cane the calorific value of a pound of Cuban bagasse is greater than that of a pound of Louisiana bagasse, due to a lower moisture content of the Cuban product. The results given in the tables at the top of p. 920 are typical.

The Louisiana varieties of sugar cane yield from 400 to 580 lb. of bagasse per ton of cane, or on an average of 20 to 30 per cent of the total amount of cane ground. In a 1000-ton house (1000 tons every 24 hours) this would amount to about 480,000 lb. a day, or from 19,500 to 21,000 lb. per hour. One pound of bagasse will evaporate from 2 to 3½ lb. of

[1] Louisiana State University.

For presentation at the Annual Meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, December 4 to 7, 1917. All papers are subject to revision.

With an 80 per cent juice extraction on weight of cane:

| Variety of Bagasse | Moisture, per cent | Fiber, per cent | Heating Value, B.t.u. per Lb. | |
|---|---|---|---|---|
| | | | Total | Net |
| Cuban | 32.8 | 60 | 5628 | 4092 |
| Louisiana | 42.8 | 50 | 4816 | 3345 |

With nearly equal moisture contents:

| Variety of Bagasse | Extraction, per cent | Moisture, per cent | Fiber, per cent | Heating Value, B.t.u. per Lb. | |
|---|---|---|---|---|---|
| | | | | Total | Net |
| Cuban | 75 | 42.6 | 48 | 4807 | 3335 |
| Louisiana | 80 | 42.8 | 50 | 4816 | 3345 |

(For a table of this kind, see La. Bulletin 117, p. 45.)

water "from and at 212 fahr." Assuming coal and fuel oil to have, respectively, calorific values of 14,000 and 19,000 B.t.u. per lb., then from 4 to 6 lb. of bagasse are equivalent to 1 lb. of coal and from 43 to 65 lb. equivalent to 1 gal. (about 7.6 lb.) of oil.

Professor Kerr found, in his latest tests at Louisiana sugar houses, that the bagasse from one ton of cane generated from 1.16 to 1.44 boiler horsepower. Thus the bagasse from a 1000-ton house for 24 hours will generate from 1160 to 1440 boiler hp. during that period of time. It would require about 60 tons of coal per day to do the same work, assuming that the coal equivalent of the bagasse from 1 ton of cane is 120 lb. It is thus seen that bagasse plays an important role as a source of fuel in the sugar house.

### METHODS USED IN DRYING BAGASSE

In former years not much attention was paid to the drying of bagasse before burning it. It was was the custom either to sun-dry it or feed it to the furnaces in a wet condition, just as it came from the mills. Of later years, however, many devices have been put into use in order to dry it partially before it is burned.

In Mauritius, apparatus known as "secheries" have been put into use for this purpose. They consist of a chamber near the chimneys, in which is arranged a system of belts alternately traveling in opposite directions. The flue gases go through this apparatus, and thus the waste heat of the gases is utilized to dry the wet bagasse. In countries where labor is cheap and fuel high, as in some parts of Egypt, other devices, whereby the bagasse is conveyed around the smoke-stack and smokebox of the boilers by means of a screw-like conveyor, have come into use to remove part of the moisture from the bagasse.

A very efficient bagasse drier has been designed by Professor Kerr (La. Bulletin 128), which is in the form of a tower-like structure. The bagasse is conveyed to the top and falls downward over a series of inclined shelves placed opposite each other. The dried bagasse is conveyed from the bottom of the drier to the furnaces. The furnace gases are used to dry the bagasse and are conveyed to the bottom of the drier and pass upward, the hottest gases coming in contact with the driest portion of the bagasse. An induced-draft system is employed, the fan being placed near the top of the drier.

Of late, especially in Cuba and Hawaii, in large factories stokers are being put into use to dry bagasse. These stokers are mainly of the step-grate type, some with front feed and others with double feed. The bagasse is fed at the top or upper back part of the stoker in the same manner as coal. They have proved to be very efficient as a means of drying bagasse, as well as in regulating the combustion or burning of the bagasse.

As to the economy of bagasse drying, many authorities claim that a great saving can be effected by drying this fuel before it is fed to the furnaces. This has been proved as a result of many experiments. Noel Deerr states that in Mauritius he found that bagasse entering a secherie with 50 per cent of moisture would leave containing only 35 per cent; this amount of water corresponds very closely with the evaporation of half the original moisture. In a calculation of the heat lost in the flue gases, he found that 565 B.t.u. per lb. of bagasse were carried away in the associated water; a saving of half of this would be 282 B.t.u., reducing the heat carried away in flue gases from 1675 to 1393 B.t.u.; or, expressed as a percentage on the total heat of 1 lb. of bagasse, the loss in the flue gases is 30.4 per cent as compared with 36.6 per cent loss calculated for wet bagasse. Professor Kerr says that in Louisiana 16 per cent of the total heat generated by the combustion of 1 lb. of bagasse is required to evaporate the moisture present. About 14½ per cent of the moisture in Louisiana bagasse was removed by drying it, and the dried bagasse had a heating value 55 per cent greater than the wet bagasse. This means that a saving of over 2½ gal. of oil will be effected per ton of cane ground. In a factory grinding 60,000 tons of cane per season this means a saving of about 154,000 gal. oil, or 3670 bbl., which, at $1.25 per bbl., means a saving of $4,587.50 per season.

### BOILER FURNACES FOR BURNING BAGASSE

As has been said before, bagasse was formerly burnt in furnaces very similar to those used for burning coal. During recent years, however, many improvements have been made along this line. In present practice furnaces of the Dutch-oven type are very widely used. Boilers of all types, including those of the Scotch-marine type, are used in connection with the Dutch-oven type of furnace.

The following shows the types of boilers in use at a few Louisiana sugar houses:

| House | Type of Boiler |
|---|---|
| Angola | Horizontal return tubular, with Dutch oven and small draft fan. |
| Cinclare | Scotch marine, with suspension furnaces and Dutch oven. |
| Poplar Grove | Stirling, with Dutch oven. |
| Adeline | Horizontal return tubular, with large and elaborate combustion chamber. |
| Vermilion | Horizontal return tubular, with Quinn flat-top furnace. |

Other types in use in Louisiana (given in Bulletin 117, La. Expt. Station) are: Babcock and Wilcox; Cook water-tube (vertical tubular); Climax water-tube (vertical tubular); and various types of boilers of the "half" and "full" Dutch-oven types.

In Demerara the Abel type of furnace is used in connection with the standard types of boilers. By using this furnace the

heated gases of combustion pass three times along the boiler. The essential difference between the Dutch-oven and Abel type of furnace is in the size of the combustion chamber, which in the latter type is much larger.

In Louisiana, the combustion chambers of sugar-house boilers are, in general, large. Where oil is burned in connection with bagasse, which is the case in many houses, there is a tendency to make the combustion chamber smaller as the burning oil causes a better combustion of the bagasse, the furnace temperatures being higher when burning these two fuels together than the furnace temperatures obtained by burning either of them alone.

The grate surface should be small in furnaces used for burning bagasse, as the rate of combustion is high, sometimes running as high as 300 lb. per hr. per sq. ft. of grate surface. This corresponds to about 20 boiler hp. per sq. ft. of grate surface. Some of the recently installed 500-hp. boilers in the tropics have only 25 sq. ft. of grate surface. Small grates require less manipulation and care in order to prevent excessive air losses than is the case with large grates, there being less danger of portions of the grate being uncovered, etc. The amount of grate surface per boiler hp. also varies with the amount of moisture in the bagasse—the less moisture there is, the smaller the grate surface can be made. In Professor Kerr's recent tests, the highest rate of combustion was at Adeline (225 lb. bagasse per hr. per sq. ft. of grate surface), while the lowest was at Vermilion (85 lb. per hr. per sq. ft.); corresponding to about 15 and 6.5 boiler hp. per unit area.

TABLE 1 DATA ON BOILER TESTS AT LOUISIANA SUGAR HOUSES

| Item | Sugar House | | |
|---|---|---|---|
| | Adeline | Angola | Vermilion |
| Bagasse burnt, per hr., lb | 3777 to 5614 | 2345 to 3441 | 3586 to 3687 |
| Moisture in bagasse, per cent | 45.4 to 53.0 | 53.1 to 58.6 | 46.3 to 47.0 |
| Grate surface, sq. ft | 25 | 25.89 | 42 |
| Heating surface, sq. ft | 2500 | 1512 | 2450 |
| Equivalent evaporation from and at 212 deg. per hr., lb | 8636 to 13093 | 2197 to 6476 | 9131 to 9469 |
| Bagasse burnt per hour per sq. ft. of grate surface, lb | 151 to 225 | 79.6 to 119 | 85.4 to 87.8 |
| Steam pressure, lb. per sq. in. abs | 97 to 119 | 87.8 to 105 | 108.7 to 109.8 |
| Quality of steam, per cent dry | 98.3 to 99.8 | 98.5 to 99.6 | 98.5 to 98.7 |
| Draft in flues, in. of water | 0.464 to 0.634 | 0.300 to 0.487 | 0.417 to 0.434 |
| Equivalent evaporation from and at 212 deg. per lb. of bagasse, lb | 2.13 to 2.35 | 1.36 to 1.90 | 2.48 to 2.64 |
| Efficiency of furnace and grate, per cent | *a*56.83 to 64.61<br>*b*63.17 to 71.93 | *a*48.96 to 60.3[illegible]<br>*b*55.26 to 67.6[illegible] | *a*61.15 to 66.65<br>*b*67.65 to 73.81 |

respectively. It is probable that a mean between these two sizes would be good practice.

It is the practice in Louisiana to use systems of forced or induced draft as a source of air supply. Bagasse contains a great amount of air, but when burned on a small amount of grate surface, with a high rate of combustion, it requires a high draft. When, however, it is burned in furnaces having a large combustion chamber and a large surface, air in nearly all cases is supplied in great excess, which lowers the efficiency of the boiler and grate. Where forced draft is used in Louisiana, the general tendency, it is found, is to supply air in great excess.

In order to show comparative figures on boiler tests at Louisiana sugar houses, a partial list of results is given in Table 1, which shows in each case the highest and lowest values obtained.

In calculating the efficiencies in Table 1, the following methods were used: Efficiency $a$ = heat leaving in steam per lb. wet bagasse divided by net heating value of 1 lb. of wet bagasse [gross heating value per pound minus (heat necessary to vaporize moisture present in it plus heat necessary to raise to stack temperature)].

Efficiency $b$ = heat leaving the steam per lb. wet bagasse divided by [net heating value per pound (same as above) plus heat required to vaporize moisture formed by the combination of the hydrogen and oxygen in the fuel]. It is probable that the latter method of calculating efficiencies is more suitable for making comparisons where there is a considerable variation in the quality of bagasse.

In conclusion, it may be said, that, although many recent improvements have been made in the methods of burning bagasse, there are yet many fields open along this same line. Methods of regulating the air supply, improvements in furnaces and driers, and utilization of the heat in the waste flue gases are some of the problems being worked upon by the sugar-house engineer of today, with a view of conserving as much of the heat as possible furnished by this most valuable by-product of the sugar house.

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The latent heat of steam of standard pressure and temperature is a fundamental constant, the value of which has long been less satisfactorily known than was desirable. The values given in Kaye and Laby's Physical and Chemical Constants differ appreciably, ranging from the 537 calories of Regnault obtained in 1847 to the 540 calories found by Joly in 1895. A new determination is described in a paper by Mr. T. Carlton-Sutton, published in a recent issue of the Proceedings of the Royal Society. The plan of the experiments consisted in weighing the quantity of steam condensed upon a bulb, both when empty and when filled with water. From the two observations the latent heat can be deduced, the value found being 538.88 mean calories. It is claimed that this figure is correct to the fourth significant figure.—*Engineering*, August 24, 1917, p. 200.

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One of the great events of the war has been to create a tremendous demand for labor at a time when a vast quantity of the best grade of labor formerly available has been taken away from useful occupations. According to the latest data published in the daily press, approximately 37,000,000 men are now engaged on the fighting lines. Somebody had to take their places. Part of their work is being done by machinery through an increased employment of automatic and semi-automatic machines, but a large share of the work could be done only by human agencies, and even where automatic machinery is employed, back of the engine must be the human hand.

Women have had to be called in, therefore, to take the place of men, and all indications point to an increased demand for female labor, at least in the next few years. In this connection the discussion of Female Labor's Place in Automotive Industry, by Allen Sinsheimer, is of interest, as the writer goes into a number of particular details. From what he states, it appears that female labor may be very advantageously employed in certain lines under certain reasonable conditions. On the other hand, it appears also from a quotation of a statement by Samuel Gompers relating to German war conditions that female labor may be easily abused with most disastrous results to the women thus misemployed.

# THE STEAM MOTOR IN THE AUTOMOTIVE FIELD

By E. T. ADAMS, SYRACUSE, N. Y.

Member of the Society

At the present time the question as to the relative fitness of the gasoline as compared with the steam motor for automotive service is receiving most serious attention. New developments and new inventions in steam motors have revolutionized the status of steam at the very time when the oil industry has reached a position absolutely the reverse of that which led to, and fostered, the growth of the gasoline engine. Two interrelated economic developments are especially noteworthy. First is the tremendous increase in the demand for automotive power. The use of the automobile has become universal, the use of the truck is at the beginning of an era of expansion which may prove equally great, and the farm tractor marks the beginning of a demand greater than all the others. The farm is the greatest single user of power; few people realize how huge a portion of the earth's surface must annually be cut into slices, turned upside down and pulverized to form a seed bed, or the expenditure of power which this involves. The excellence of the gasoline motor has led to its adoption for this and for other service for which it is economically unfitted, and we are fast working toward a condition where gasoline alone is not produced in sufficient quantity to meet the demand.

> ***The tremendous increase in the demand for automotive power has outdistanced the ability of the gasoline engine to meet this demand, chiefly for the reason that the supply of fuel is not now equal to the requirements.***
>
> ***The steam unit has many advantages for automotive service. Its high torque at low speed, its overload capacity, its smooth, flexible speed and power control have remained the standards of excellence reached for but never attained by any gasoline motor.***
>
> ***The design of the steam unit is simple, and many features of construction have been introduced which tend toward long life and low cost of upkeep.***
>
> ***The difference in cost between gasoline and power oil, when coupled with a reduced cost of lubricating oil, represents an appreciable reduction in fuel cost in favor of the steam unit and one of importance to the truck and tractor operator.***
>
> ***Numbers of new steam trucks, tractors and pleasure cars are in service, or in process of manufacture or design. This effort and this demand will have a profound influence on the automotive industry.***

Second is the fuel situation. When the automobile industry was young the oil industry was dependent on the use of oil for light, and gasoline was a by-product,—cheap, abundant and of excellent quality. Today the oil industry is based on oil for power, and gasoline is its foremost product. The supply, even with lowered quality and new processes of manufacture, is not equal to the demand, and the price is too high for many commercial uses. There will be some gain due to the perfection of vaporizing types of carburetor which will permit further lowering of the quality of gasoline, and some gain due to increased attention to economy, but the growth of the use of power in this field will be greatly hampered unless there is an increase in the quantity of fuel available far greater than can be expected from this source alone. This means the use of oils other than gasoline, and of methods other than carburetion and burning in an internal-combustion engine.

The steam-driven motor is the type which most readily meets this condition, and its use will receive a further impetus because the demand for gasoline is a seasonable demand and a steam unit using unpurified kerosene or similar light distillates will use these by-products of gasoline manufacture during the season in which they are produced. These by-products are produced in great quantities, are relatively cheap and furnish an ideal fuel for the small-power steam boiler.

The steam unit has many advantages for automotive service. Its high torque at low speed, its overload capacity, its smooth, flexible speed and power control have remained the standards of excellence reached for but never attained by any gasoline motor. The connection from motor to axle is simple and direct, without clutch, reverse or change gears. Steam is available at full boiler pressure and for practically full stroke to give torque to lift a loaded rear axle slowly and gently from a rut. Ahead and reverse follow the movement of a single lever, and acceleration and hill-climbing capacity hitherto unknown are at the operator's command.

High steam pressures and temperatures have been the rule, but a light, compact motor construction and high economy are attainable with steam pressures between 400 and 500 lb. gage, and thereby we avoid the tendency to carbonize the lubricating oil which is found at higher temperatures. There has been much interesting speculation on the economies due to the use of higher steam pressures and the best division of a given total heat between superheat and the temperature due to evaporation. But in the small units here considered, practical considerations such as have been outlined will doubtless govern design.

The chief force which is bringing about the increased use of the steam motor is its superior fitness for automotive service, especially in the commercial field. First, in truck service the upkeep of the gasoline truck, even with the expert service, is now beyond reason and is a serious handicap to the business. Overloading and incompetent handling are blamed for this condition, but, practically, overloading is not preventable, and starting from a bad position is an unavoidable hazard. Racing the motor, coupled with the sudden application of the clutch, is the only answer to these conditions which the gasoline motor affords. The result is destructive to both power plant and transmission. The steam motor meets this situation by using steam for practically the full stroke of the piston and at any pressure which the tractive power of the wheel will permit.

For presentation at the Annual Meeting of The American Society of Mechanical Engineers, New York, December 4 to 7, 1917. The paper is here printed in abstract form, and advance copies of the complete paper may be obtained gratis upon application. All papers are subject to revision.

The available mean effective pressure on the steam piston under these conditions is fully five times the maximum available with a gasoline motor, and the motor speed for the same torque may be correspondingly low. With the steam unit the load is picked up gently, exactly as a locomotive starts a train. This tends toward low cost of upkeep.

Another point in favor of the steam unit is the extreme simplicity of the transmission—one pair of bevels or spurs, or direct drive on the worm shaft is all that is required for light and moderate power work, with one additional reduction for heavy work and tractor service. There is no clutch, no reverse gear—only a simple direct drive from motor to axle. This again tends toward low upkeep and long life.

In early constructions the motor naturally followed locomotive or marine lines. Modern steam motors are preferably of the multiple-cylinder type, designed for quantity production using the tool equipment and shop methods of the modern gasoline-motor manufacturer. They are carefully balanced, are light and simple and capable of as high speed as may be desired. The uniflow type is largely used because of its simplicity and its high economy when operated non-condensing. Because of the high steam pressure, the most economical mean effective pressure is about the same as the full-load m.e.p. of the gasoline motor, and for the same power the cylinder sizes are about the same in the two cases. With this construction piston and valve require but little lubrication, the amount of lubricating oil necessary being far less than that used by older types of steam or by modern types of gasoline motors. The pistons and rods follow automobile practice. Alloy steel and aluminum are freely employed and ball-bearing construction is used where possible. Crankshafts and pins are oiled by a forced-lubrication system, bearing areas are ample, and the labor cost for adjustment and repair is naturally extremely low.

Boiler design exhibits greater variety than any other portion of the steam unit. The cylindrical fire-tube types, both with and without a water leg, have their advocates. The ordinary flash type is in use but not so much in favor, due, among other things, to its especial tendency to carbonize any lubricating oil introduced with the fuel. Tube boilers with natural or forced circulation are popular and effective. A forced circulation, contraflow-tube type seems especially commendable in that it may be forced to almost any degree and is, therefore, responsive, light, compact and economical. The stack temperatures are readily brought down to 50 deg. above feed temperatures; the superheat is under good control and danger of burning or injury to the tubes is negligible. One advantage of the tube type is its absolute safety from destructive explosions.

All these features exhibit a very great advance over older constructions. They are popular because of their economy and safety, and because all these improvements tend toward longer life and lower cost of upkeep.

The furnace is the most important feature of the modern unit. All precedent is swept aside. With a light power oil as the established fuel, there is no excuse for following old practice and merely firing oil into a combustion space originally designed for coal, and in later designs this is not done. First, proper conditions are established for burning the oil; second, proper conditions are established for utilizing the heat thus generated, and these are then combined. In one installation this leads to a design with the furnace practically at the top of the boiler, with force feed of oil and air; this has proved a most acceptable and desirable location.

Various methods of controlling the oil are in general service. In the oldest type the oil under pressure is converted into a highly superheated vapor, which discharges past an adjustable needle valve drawing with it an air supply, fed and controlled as in a bunsen burner. After proper mixing the mixture is burned as it issues from fine perforations in the grate. A pilot light which keeps the oil supply superheated is a necessary part of the equipment. In spite of its high economy and its honorable record in service, this system is steadily being displaced in the more modern designs. Objection is made that under certain conditions the pilot light and the heated oil under pressure are highly dangerous, and the clogging of the control valve by carbon and tars formed by the cracking of the oil is objectionable and expensive.

The mechanical atomizer of the type used in larger furnaces and with heavier oils does not appear in use, but would seem to be well suited to the service. New systems of this general class are being very extensively tried out. These systems are important because they consider not only the proper burning of the oil, but also the commercially more important item of control. Considered as a unit, the vital control of the motor must be at the furnace. There must be control in proportion to load, to steam pressure, and to maximum steam temperature, and also control directly responsive to the demands of the public. In a pleasure car, starting from cold, there must be steam to enable the car to be driven away in one minute. The mechanism or control, to be commercially successful, must be no more burdensome than the movement of a lever or the throwing of a switch. In a truck or tractor the demands are somewhat more moderate; but in general the steam unit must be practically on a par, in the matter of starting, with the gasoline unit, and the fact that in this respect also steam is now on a par with gasoline is one reason for the present impetus toward steam.

Where both air and oil are metered in under forced draft and in a boiler as flexible as those here described, it appears that a simple and entirely satisfactory method of heat graduation is to "cut in and cut out"; that is, to stop the supply of both oil and air entirely where it is desired to limit pressure or temperature, and to cut in again at full power when the pressure or temperature falls, this action, of course, being entirely automatic. With the safety which a tube boiler provides, a satisfactory system of water supply is a feed pump operated by any means whose speed or time of operation is directly proportional to the load. This involves attention to the water level and occasional adjustment by the operator, but as there is no serious penalty for his failure this seems an entirely satisfactory method—perhaps more satisfactory than a type more strictly automatic.

Next to the fuel situation and the desire for reduced cost of upkeep, this new system of control is the most important development affecting the renaissance of the steam motor in the automotive field.

The exhaust is condensed to atmospheric pressure in an ordinary type of automobile radiator. The type with wide surfaces and thin water spaces has proved most effective. In a pleasure car complete condensation is secured in a small radiator often without the use of a fan. The efficiency of the radiator is reduced by excessive oil in the feed, but otherwise there are no disagreeable effects. Under these conditions fresh-water supply is only needed at rare intervals, which again is a feature which has served greatly to increase the demand for the steam motor.

It is characteristic of the internal-combustion motor that it gives its highest economy at its maximum load, with rapid reduction in economy as the load is decreased. The reverse is

true of the steam unit. It results from this that under usual operating conditions the steam unit is operating at its maximum efficiency, whereas the gasoline unit is operating at only fair efficiency. These efficiencies tend to meet, and in the two cases in actual service the quantity of fuel per brake horsepower should not be materially different.

The difference in cost between gasoline and power oil, when coupled with a reduced cost of lubricating oil, represents an appreciable reduction in fuel cost in favor of the steam unit and one of importance to the truck and tractor operator. In the case of the automobile where a small horsepower represents great mileage, this item is of lesser importance; but it lends romance to engineering to note that the joy of driving the smooth, flexible steam motor is likely to cause its extensive adoption first in the field which commercially needs it least.

# WORK OF THE BOILER CODE COMMITTEE

*THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the Code is requested to communicate with the Secretary of the Committee, Mr. C. W. Obert, 29 West 39th St., New York City.*

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and passed upon at a regular meeting of the Committee. This interpretation is later submitted to the Council of the Society for approval, after which it is issued to the inquirer and simultaneously published in THE JOURNAL, in order that any one interested may readily secure the latest information concerning the interpretation.

Below are given the interpretations of the Committee in Cases Nos. 174-176, inclusive, as formulated at the meeting of September 20, and approved by the Council on October 12, 1917. In this report, as previously, the names of inquirers have been omitted.

## CASE NO. 174

*Inquiry:* What type of stays does Par. 200 of the Boiler Code refer to in its requirements for the drilling of tell-tale holes in their ends? The rules of the Interstate Commerce Commission establish the distinction that all stays shorter than 8 in. in length shall be termed staybolts.

*Reply:* It has been proposed to revise Par. 200 to read as follows:

> 200 *Staybolts.* The ends of screwed staybolts shall be riveted over or upset by equivalent process. Staybolts must be hollow or the outside ends of solid staybolts, 8 in. and less in length, shall be drilled with a hole at least $\frac{3}{16}$ in. diameter to a depth extending at least $\frac{1}{2}$ in. beyond the inside of the plates, except on boilers having a grate area not exceeding 15 sq. ft., or the equivalent in gas or oil-fired boilers, where the drilling of the staybolts is optional. Solid staybolts over 8 in. long and flexible staybolts of either the jointed or ball and socket type need not be drilled.

## CASE NO. 175

*Inquiry:* Is it necessary under the rules of the A.S.M.E. Boiler Code that the outside firebox plate of locomotive type boilers be of the same thickness as the barrel sheets when it is reinforced by stays to the inner firebox sheet? It is customary in locomotive boiler practice to make the outside firebox plate of less thickness than the barrel plate for reason of this staying.

*Reply:* The Committee now has this matter under consideration and will render a formal reply as soon as the investigations now under way have been completed.

## CASE NO. 176

*Inquiry:* What factor of safety shall be used under the rules of the Boiler Code, *a.* when the longitudinal joint of a dome less than 24 in. in diameter is lap riveted, and, *b.* when such dome is attached to the shell of the boiler by a flanged ring construction in accordance with Par. 261?

*Reply:* When the longitudinal joint of a dome less than 24 in. in diameter is lap riveted, the longitudinal barrel of the dome must be designed on the basis of a factor of safety of not less than 8. When such a dome is attached to the shell of the boiler by a flanged ring construction, in accordance with Par. 261, the flanged construction shall have a factor of safety of not less than 5, but this does not involve any change in the factor of safety of not less than 8 in the dome barrel.

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The Governor of Michigan has appointed the following men as members of the Board of Boiler Rules, in accordance with the terms of the Hanley Act, passed by the legislature last winter: G. W. Bissell, East Lansing; E. C. Fisher, Saginaw; J. C. McCabe, Detroit; S. Milan, Grand Rapids; G. E. Christensen, Houghton.

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Autogenous welding entered upon what is bound to be a fruitful period when recently in the Engineering Societies Building, New York City, committees of various societies and manufacturers met and formed the National Welding Council. All the industries were represented, together with the insurance companies and the constituted authorities, such, for example, as represented by J. C. McCabe, safety engineer for the City of Detroit.

The purpose of the National Welding Council is, in the beginning, at least, divided into four divisions, to accomplish the following ends: Uniformity of design of pressure vessels to be autogenous welded; licensing of welders for pressure-vessel work; research to determine an infallible test that will reveal unsafe welds, and fourth, to investigate the micro-structure and physics of welds. As autogenous welding is so attractive on account of both the cost and the time of doing such work, the development of the art as applied to pressure vessels suffers because engineers who represent the public as well as private interests cannot be certain of the safety of an autogenous weld. The frank statements by Mr. McCabe, and by the insurance interests represented at the meeting by T. T. Parker, of the Fidelity and Casualty Co., and J. G. Shaw, of the Travelers Insurance Co., were most commendable. These gentlemen gave the welders to understand that until some reliable tests that would enable one to determine the safety of a weld had been found, they would not permit of the use of welds in pressure vessels subject to tension. This also is the attitude of responsible engineers, many of whom have applied welds to pressure vessels that are unlikely to rupture or other accident, and which, if ruptured, will not cause serious damage to surrounding property or loss of life.—*Power*, Oct. 9, 1917.

# CORRESPONDENCE

***Contributions** to the Correspondence Departments of The Journal by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in The Journal, or brief articles of current interest to mechanical engineers.*

## Inspection in Munitions Manufacture

To the Editor:

In his paper on The Importance of Intelligent Inspection in Munitions Manufacture, presented at the Spring Meeting of the Society at Cincinnati in May of this year, Mr. Walsh put forth some statements and considerations in regard to difficulties experienced in the inspection of big artillery orders in the United States in 1915-16.

The members of the Russian Artillery Commission readily acknowledge the justice and value of Mr. Walsh's statements, as well as those in other papers presented at the same meeting.

Unfortunately for some who were not familiar with the execution of an order by the Canadian Car & Foundry Company for 5,000,000 3-in. shrapnel and high-explosive shells for the Russian Government, some expressions in Mr. Walsh's paper and examples used in his illustrations may be understood in an undesirable way from the standpoint of the Russian Commission, and may be interpreted and generalized in such a way which, we hope, the author himself did not have in view.

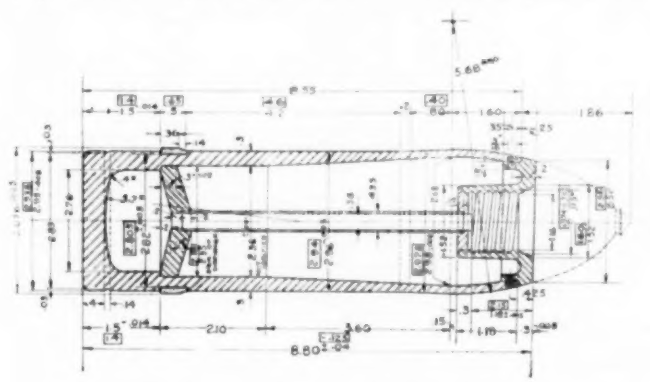

Fig. 1 Additional Tolerances for Russian Shells

For example, in Par. 2 Mr. Walsh states: "Russia was as little prepared to provide the required number of qualified inspectors as was the contractor, and in consequence the manufacturer had inflicted upon him so-called inspectors who were selected from every walk in life, it seemed, except the mechanical, and barbers, bartenders, butchers, students and teachers were the usual thing and the practical man the exception."

The inspectors who were selected, as the author justly points, "from every walk of life except the mechanical," were not, in reality, the Russian inspectors, but the inspectors of the contractors, who were eventually taught by the Russian representatives. Naturally, the provision of all the necessary number of inspectors from Russia to America during the war could not and should not be realized. The Russian Government sent to the United States, as it did to Japan, England and France, a small contingent of skilled inspectors, under the supervision of whom were the American inspectors.

We readily admit that even an inspector thoroughly familiar with his business is not free sometimes from extreme strictness, and sometimes even from so-called "discretion," but we wish to draw attention to the fact that every sub-contractor, for whom each requirement of the inspector results in a loss of money, is naturally inclined to exaggerate, in a disadvantageous manner, the actions of the inspectors, so it would be well to look upon such statements with prudence, and particularly when such statements cannot be verified. That, in the main, the Russian inspection was not too strict is indicated by Fig. 1 given herewith, which shows additional tolerances which, it is true, were not announced to the factory and which were used by the Russian representatives, and only owing to which, however good the production, can be explained the fact that the whole quantity of finally rejected shells did not exceed 1 to 1½ per cent.

It is interesting to note in respect to this, that out of the total number of accepted complete rounds, only 40 per cent of that number were fully in accordance with the contract specifications; the other 60 per cent did not conform with contract specifications.

All Russian inspectors who had an opportunity to see Mr. Walsh's paper cannot help but agree with the statements made by him in Pars. 5 to 12 with regard to technicalities of inspection.

Russian 3-in. Shell Department,
Captain S. N. Petrenko.

## Heat Transfer in Condensers

To the Editor:

The transfer of heat in surface condensers is a subject which has frequently been discussed in the Society's proceedings, so that the following method of determining one factor may be of interest.

The design of surface condensers, water heaters, and, generally, any apparatus for the heating or cooling of fluids where the hot medium is never mixed with the cold one, requires the determination of the mean temperature difference.

Suppose two fluids, $A$ and $B$, to enter a vessel in separate compartments for the interchange of heat.

Let $T_1$ = temperature of fluid $A$ at the point at which it begins to have contact with fluid $B$

$T_2$ = temperature of fluid $B$ at the point at which it begins to have contact with fluid $A$

$T_3$ = temperature of fluid $A$ at the point at which it ceases to have contact with fluid $B$

$T_4$ = temperature of fluid $B$ at the point at which it ceases to have contact with fluid $A$.

Then, for parallel flow, Fig. 1, the difference in temperature at the beginning of contact is $T_1 - T_2$, and the difference where the fluids cease to have contact is $T_3 - T_4$.

For counter-current flow, Fig. 2, the difference in temperature at beginning of contact is $T_1 - T_4$, and the difference where the fluids cease to be in contact is $T_3 - T_2$.

If the differences in temperature are represented by $D_1$ and $D_2$, then

For parallel flow, $D_1 = T_1 - T_2$ and $D_2 = T_3 - T_4$

For counter-current flow, $D_1 = T_1 - T_4$ and $D_2 = T_3 - T_2$

Let $D_m$ = mean temperature difference; then, according to Hausbrand,[1]

$$D_m = \frac{D_1 - D_2}{\log_e(D_1/D_2)}$$

This formula can be equally well written

$$D_m = \frac{D_2 - D_1}{\log_e(D_2/D_1)}$$

as can be shown by a simple algebraic proof. Hence it makes no difference whether $D_1$, as determined by the rule above, is greater or less than $D_2$. The numerator of the fraction must always be positive, and the denominator must be the Napierian logarithm of an improper fraction.

In determining the design of a piece of apparatus it is often necessary to solve this formula three or four times, as it rarely happens that stock designs will fit a specific case exactly. It is also often desirable to determine the effect upon the apparatus of slight changes in the conditions.

A ready means of solving the formula rapidly is shown in the calculating chart, Fig. 3, which will give solutions in a few seconds, accurate enough for all practical purposes. The chart

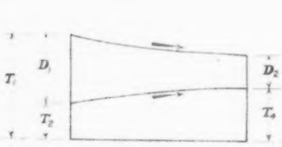

FIG. 1

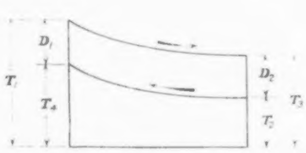

FIG. 2

FIG. 1 FLUIDS ENTERING COMPARTMENTS IN PARALLEL FLOW
FIG. 2 FLUIDS ENTERING COMPARTMENTS IN COUNTER-CURRENT FLOW

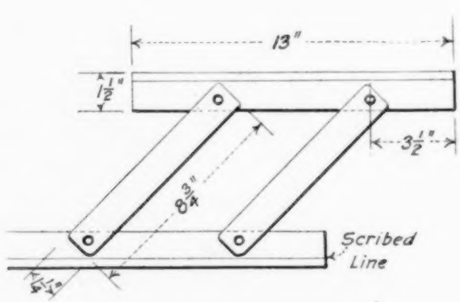


FIG. 4 SCRIBED PARALLEL RULE

is made up of four scales: On the left-hand side of the left-hand scale the values of $D_1$ are plotted; the right-hand scale contains the values of $D_2$; the difference between these quantities, $D_1 - D_2$, is plotted on the right-hand side of the left-hand ($D_1$) scale; the diagonal scale gives the values of $D_m$, the mean temperature difference.

To use the chart, join the given values of $D_1$ and $D_2$ with a straight line, and draw a line parallel to this line through their difference, $D_1 - D_2$. This line will intersect the $D_m$ scale at the required value.

An example will show the procedure. Steam enters a closed parallel-flow heater at 215 deg. fahr. and water enters at 50 deg. fahr.; the steam leaves at 212 deg. fahr. and the water is heated to 180 deg. fahr.

$T_1 = 215$
$T_2 = 50$ $\qquad D_1 = T_1 - T_2 = 215 - 50 = 165$
$T_3 = 212$ $\qquad D_2 = T_3 - T_4 = 212 - 180 = 32$
$T_4 = 180$ $\qquad D_1 - D_2 = 165 - 32 = 133$

Join 165 on $D_1$ scale with 32 on $D_2$ scale and draw a parallel line through 133 on the $D_1 - D_2$ scale; this cuts the $D_m$ scale at 81.2, the required value of mean temperature difference. Numerical solution gives the answer as 81.05.

The chart depends upon the principles of similar triangles. A proof of the principles upon which it is constructed may be found in the *Journal of the Western Society of Engineers*, February 1911, Vol XVI, No. 2, p. 112.

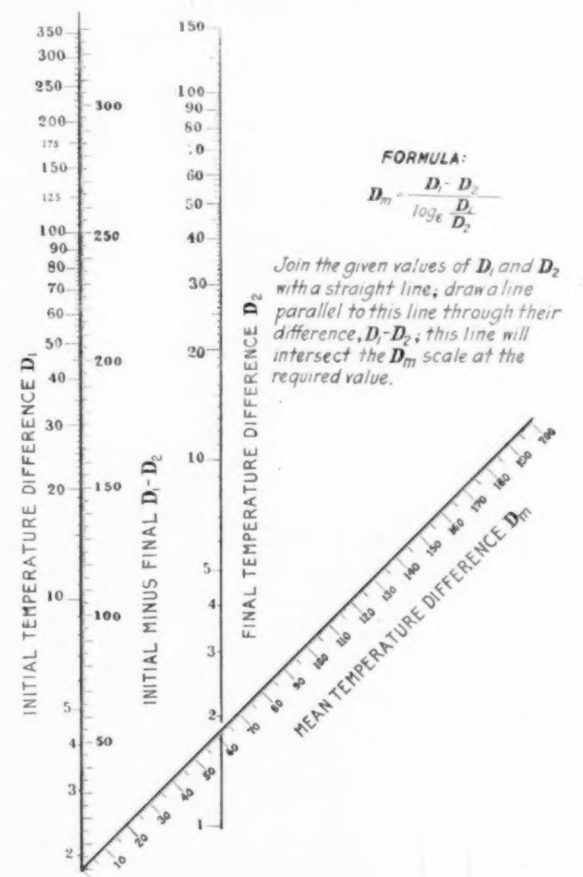


FIG. 3 CHART FOR DETERMINING MEAN TEMPERATURE DIFFERENCE

A convenient device for using the chart is a parallel rule made of transparent celluloid about 0.025 in. or 0.03 in. thick, with fine lines scribed on the under side of the parallel links. Such a rule is illustrated in Fig. 4.

HOWARD M. INGHAM.

New York, N. Y.

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At the annual meeting of the national advisory committee for aeronautics held recently, Dr. W. F. Durand, Mem.Am. Soc.M.E., was reelected chairman and Dr. S. W. Stratton, Mem.Am.Soc.M.E., was reelected secretary. Members of the executive committee were elected as follows: Dr Joseph S. Ames, Dr. Charles F. Marvin, Dr. Michael I. Pupin, Major-General George O. Squier, U. S. A.; Dr. S. W. Stratton, Mem.Am.Soc.M.E.; Rear-Admiral D. W. Taylor, U. S. N., and Dr. Charles D. Walcott. At the organization meeting of the executive committee, Dr. Charles D. Walcott was elected chairman and Dr. S. W. Stratton, secretary.

[1] Evaporating, Condensing and Cooling Apparatus, by E. Hausbrand. For Hausbrand's formula, see Trans. Am.Soc.M.E., vol. 32, pp. 1151 and 1211.

# Society Affairs

# Engineering Survey

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# THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ABRIDGED LIST OF OFFICERS AND COMMITTEES[1]

## OFFICERS AND COUNCIL, 1917

**President**

Ira N. Hollis

**Past-Presidents**

Members of the Council for 1917

Alex. C. Humphreys
W. F. M. Goss
James Hartness
John A. Brashear
D. S. Jacobus

**Vice-Presidents**

Terms expire December 1917

Wm. B. Jackson
J. Sellers Bancroft
Julian Kennedy

Terms expire December 1918

Charles H. Benjamin
Arthur M. Greene, Jr.
Charles T. Plunkett

**Managers**

Terms expire December 1917

Charles T. Main
Spencer Miller
Max Toltz

Terms expire December 1918

John H. Barr
H. de B. Parsons
John A. Stevens

Terms expire December 1919

Robert H. Fernald
William B. Gregory
C. R. Weymouth

**Chairman of Finance Committee**

Robert M. Dixon

**Treasurer**

William H. Wiley

**Honorary Secretary**

Frederick R. Hutton

**Secretary**

Calvin W. Rice

**Executive Committee of the Council**

Ira N. Hollis, *Chairman*
John H. Barr
Arthur M. Greene, Jr.
D. S. Jacobus
Charles T. Main
Spencer Miller

## COMMITTEES, ETC.

### STANDING COMMITTEES

*Chairmen*

Finance, Robert M. Dixon
Meetings, Robert H. Fernald
Publication, Fred. R. Low
Membership, Hosea Webster
Library, John W. Lieb
House, Frederick A. Scheffler
Research, R. J. S. Pigott
Constitution and By-Laws, F. R. Hutton
Standardization, Henry Hess

### SOCIETY REPRESENTATION

American Association Advancement of Science
American Society Testing Materials, Joint Conference Committee
American Society for Testing Materials, Modification Briggs Standard for Pipe Threads
Classification of Technical Literature
Conference Committee on Electrical Engineering Standards
Conference Committee of National Engineering Societies
Conservation
Engineering Council
Engineering Foundation
Expert Testimony Committee
John Fritz Medal, Board of Award
Joseph A. Holmes Memorial Association
Military Engineering Committee of New York
National Defense Committee
Naval Consulting Board of the United States
Standardization of Pipe and Pipe Fittings for Fire Protection
Trustees United Engineering Society

### SPECIAL COMMITTEES

*Chairmen*

Administration, Robert M. Dixon
American Engineering Service Committee George J. Foran
Am. Soc. M. E. Junior Prizes, L. P. Alford
Am. Soc. M. E. Student Prizes
Boiler Code Committee, John A. Stevens
Sub-Committee to Confer with Committee of A. S. T. M. on Matters Pertaining to Materials, Specifications, in Code
Conference Committee on American Engineering Standards
Conference Committee to Determine Cost of Electric Power, D. C. Jackson
Engineering Education
Engineering Resources, George J. Foran
Feedwater Standardization
Flanges and Pipe Fittings
Gages, H. E. Harris
Increase of Membership, A. L. Williston
Joint Committee on Standards for Graphic Presentation, Willard C. Brinton.
Local Sections, D. Robert Yarnall
Machine Tools Standardization
National Defense Committee
National Museum
Nominating Committee, L. E. Strothman
Patent Laws
Pipe Threads, International Standard, Edwin M. Herr
Power Tests, Geo. H. Barrus
Refrigeration, D. S. Jacobus
Research Committee,
Sub-Committee on Bearing Metals, C. H. Bierbaum
Sub-Committee on Cutting Action of Machine Tools, Leon P. Alford
Sub-Committee on Fuel Oil, Raymond H. Danforth
Sub-Committee on Investigation of the Clinkering of Coal, Lionel S. Marks
Sub-Committee on Lubrication, Albert Kingsbury
Sub-Committee on Materials of Electrical Engineering
Sub-Committee on Safety Valves
Sub-Committee on Steam Flow Meters, R. J. S. Pigott
Sub-Committee on Worm Gearing, Fred. A. Halsey
Roller Chains, C. H. Benjamin
Standardization of Machine-Screw Nuts (Joint Committee with S. A. E.) E. H. Ehrman
Student Branches, Frederick R. Hutton
Technical Nomenclature, W. D. Ennis
Tellers of Election, Robert H. Kirk
Tolerances in Screw Thread Fits, L. D. Burlingame
U. S. Bureau of Mines, Advisory Committee
Sub-Committee on Mining Equipment
Sub-Committee on Fuels
Weights and Measures, L. D. Burlingame

### SECTIONS COMMITTEES

*Chairmen and Secretaries*

Atlanta, Oscar Elsas, Cecil P. Poole
Baltimore, W. W. Varney, A. G. Christie
Birmingham, J. H. Klinck, W. L. Roueche
Boston, A. C. Ashton, W. G. Starkweather
Buffalo, To be appointed
Chicago, A. D. Bailey, A. L. Rice
Cincinnati, To be appointed
Connecticut State, H. B. Sargent, to be appointed
Bridgeport, H. E. Harris, E. L. Fletcher
Hartford, B. M. W. Hanson, S. F. Jeter
Meriden, C. K. Decherd, to be appointed
New Haven, H. B. Sargent, E. H. Lockwood
Waterbury, W. H. Bristol, M. J. Dempsey
Detroit, G. W. Bissell, S. J. Hoexter
Erie, To be appointed, M. E. Smith
Indianapolis, W. H. Insley, to be appointed
Los Angeles, F. G. Pease, T. J. Royer
Milwaukee, W. M. White, F. H. Dorner
Minnesota, H. L. Brink, E. A. Wilhelm
New Haven, H. B. Sargent, E. H. Lockwood
New Orleans, H. L. Hutson, E. W. Carr
New York, To be appointed
Ontario, R. W. Angus, Chester B. Hamilton, Jr.
Philadelphia, L. F. Moody, J. P. Mudd
St. Louis, R. L. Radcliffe, E. H. Tenney
San Francisco, B. F. Raber, C. H. Delany
Worcester, Geo. I. Rockwood, H. P. Fairfield, pro tem

Engineering Council, Ira N. Hollis, Chairman, Calvert Townley, Secretary

[1] A complete list of the officers and committees of the Society will be found in the Year Book for 1917 and in the March, 1917, issue of The Journal.

# SOCIETY AFFAIRS

**.l of the Current Activities of the Society, Its Members, Council, Committees. Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership**

## ANNUAL MEETING PROGRAM

### New York, December 4 to 7, 1917

**Tuesday, December 4**

12.00 m. Opening of Registration Bureau in Engineering Societies Building

2.00 p.m. Council Meeting

8.30 p.m. Report of Tellers of Election and Introduction of the President-elect
Conferring of Honorary Membership upon Major-General George W. Goethals, followed by an address by Hon. William H. Taft
Reception by the President and the President-elect

**Wednesday, December 5**

9.45 a.m. Business Meeting, to be followed by the Keynote Session

*It will be suggested to the Council that the Business Meeting be adjourned to Thursday morning to allow more time for the Keynote Session*

10.00 a.m. Keynote Session on The Service of the Engineer to the Public in Times of Crises

Universal Public Service in Peace and War, Dr. Ira N. Hollis. This will be the presidential address by Dr. Hollis, after which there will be other addresses by distinguished men of national reputation on the following subjects relating to problems incident to the war: Agricultural problem; fuel problem; transportation; motor transportation; building of a merchant marine; aircraft problem; special education in time of war; engineering research. This will be an all-day session

12.30 p.m. Buffet Luncheon

2.00 p.m. Continuation of Keynote Session on The Service of the Engineer to the Public in Times of Crises

2.30 p.m. Simultaneous Sessions

**POWER-PLANT SESSION**

Preventable Waste of Coal in the United States, David Moffat Myers

The Cooling of Water for Power Plant Purposes, C. C. Thomas

Bagasse as a Source of Fuel, E. C. Freeland

The Steam Motor in the Automotive Field, E. T. Adams

**GENERAL SESSION**

The Transfer of Heat Between a Flowing Gas and a Containing Flue, Lawford H. Fry

A Study of Surface Resistance with Glass as the Transmission Medium, H. R. Hammond and C. W. Holmberg

Cooling and Drying Air and the Removing of Infinitesimal Dust Therefrom, W. J. Baldwin.

Recent Developments in Balancing Apparatus, N. W. Akimoff.

Plotting Blower-Test Curves, A. H. Anderson (*By title only.*)

Cross-Current Predeterminations from Crank-Effort Diagrams, Louis Illmer (*By title only.*)

**INDUSTRIAL-SAFETY SESSION**

Several codes will be presented for discussion by the Sub-Committee on Protection of Industrial Workers, among them Codes of Safety Standards for Elevators and Woodworking Machinery.

*(Continued on Next Page.)*

## Wednesday, December 5 (*Continued*)

3.00 p.m. Ladies' Reception and Tea

8.15 p.m. Smoker

Get-together meeting for members. Mr. John R. Freeman, Past-President Am.Soc.M.E., will give an illustrated talk upon his trip to the Orient taken last winter with Dr. John A. Brashear and Mr. Ambrose Swasey, Past-Presidents Am.Soc.M.E. Music by Glee Club. Refreshments

## Thursday, December 6

10.00 a.m. Business Meeting continued, followed by General Sessions

### Local-Sections Session

This session will be held under the direction of the Sections Committee, for a discussion of the work of the Sections and of Society Affairs, by representatives of the 24 Sections of the Society

### General Session

An Account of the Engineering Work of E. D. Leavitt, F. W. Dean

Expenses and Costs, H. L. Gantt

*The following papers contributed by Local Sections will be presented by title:*

By-Product Coke and Coking Operations, C. J. Ramsburg and F. W. Sperr, Jr.

The Submarine, C. H. Bedell

Combined Stresses, A. L. Jenkins

The Trumble Refining Process, N. W. Thompson

12.30 p.m. Luncheon, at which there will be an address on The Relation of Industrial Management to Engineering, by Prof. Dexter S. Kimball

2.30 p.m. Simultaneous Sessions

### Machine-Shop Session

*Under the auspices of the Sub-Committee on Machine Shop Practice*

Topical Discussion on the subject of Inspection with the following introductory discussions:

The Logic of Inspection, A. L. DeLeeuw

The Relation of Inspection to Product, F. A. Waldron

General Principles of Government Inspection and Relations Between Inspectors and Manufacturers, Col. B. W. Dunn

### Textile Session

*Under the auspices of the Sub-Committee on Textiles*

Labor-Turnover Records and the Labor Problem, Richard B. Gregg

Accident Prevention in the Textile Industry, David S. Beyer

The Moisture Content of Textiles and Some of its Effects, William D. Hartshorne

8.30 p.m. Lecture and Annual Reunion

The Beautiful in Commonplace Things, Dr. John A. Brashear. Following the lecture there will be a reunion and dance, with refreshments, on the fifth floor of the Engineering Societies Building

## Friday, December 7

10.00 a.m. Simultaneous Sessions

### Management Session

Topical discussion on the Employment of Women in the Skilled Industries, with particular reference to war conditions. To be introduced by Mr. John W. Upp, General Electric Co., and Mr. C. B. Lord, Wagner Electric Manufacturing Co.

The Engineer, the Cripple and the New Education, by Major Frank B. Gilbreth

### Power-Test Hearing

A public hearing by the Power Test Committee, preliminary to a proposed revision of the Power Test Code of the Society, comprising rules for conducting tests on prime movers of different types, and auxiliary apparatus

2.00 p.m. Council Meeting

***NOTE:—The above program was tentatively accepted at the meeting of the Committee on Meetings on October 26. It is possible that the arrangement of sessions may be modified slightly, but the program is issued in the present form to enable members and others to make their arrangements to attend the meeting. In the final program some of the features here announced will be augmented***

# COUNCIL NOTES

THE October meeting of the Council, the first meeting following the summer recess, was held on October 12 to enable President Hollis to attend before leaving for his visit to the Pacific Coast Sections. The following members were present: Ira N. Hollis, *President;* John H. Barr, C. H. Benjamin, Robert H. Fernald, Frederick R. Hutton, D. S. Jacobus, C. T. Main, C. T. Plunkett, John A. Stevens, and Calvin W. Rice, *Secretary.*

*Executive Committee.* Actions of the Executive Committee, taken on June 2, 21 and July 13, were made the basis of the following minutes:

It was voted to approve the appointment of the Committee on Coöperation and Organization, Mr. Fred J. Miller, *Chairman;* Messrs. L. P. Alford, Elmer H. Neff and F. A. Waldron.

Messrs. Victor J. Azbe, Bert L. Baldwin, T. J. Cookson, G. F. Gebhardt, J. J. Hoppes and F. E. Idell were approved as a Committee on Standardization of Feedwater Heaters.

Messrs. E. H. Ahara, G. M. Bartlett, C. H. Benjamin, J. R. Cantley, J. J. Flather, F. V. Hetzel and F. Morse were approved as a Committee on Standardization of Roller Chains.

Interpretations No. 153 to 161 of the Boiler Code Committee were approved.

Messrs. H. E. Harris, *Chairman;* John H. Barr, William A. Viall and L. A. Fischer were approved as a committee of this Society to develop a central bureau for the certification of gages and for the consideration of adequate facilities for certifying gages used throughout the United States in the manufacture and inspection of munitions of war.

Additional appropriations to the House Committee, Publication Committee and Committee on Engineering Resources, as recommended and approved by the Finance Committee, were approved.

*Remission of Dues.* The Committee on Constitution and By-Laws was requested to draw a by-law providing for the automatic remission of dues of a member reaching a certain age or having paid dues for a certain number of years.

*Dues of Members in Military Service.* The Secretary was requested to prepare a list of all members now in military service, to be published and distributed at the Annual Meeting.

It was the sense of the Council that such members should have their dues absolutely remitted for the period of the war and until six months after the declaration of peace.

*Increase of Membership Committee.* S. J. Hoexter was appointed chairman of the Michigan sub-committee, and C. R. Bart chairman of the Ontario, Canada, sub-committee.

*Power Test Committee.* It was voted to conduct a public hearing of the Power Test Code at the forthcoming Annual Meeting. Announcement of this hearing is given elsewhere in this issue.

An Advisory Committee was appointed to attend this and future hearings, and to confer with the Power Test Committee on request.

*American Engineering Standards.* The report of this committee was approved, and Messrs. Henry Hess, W. F. Kiesel and Carl Schwartz were appointed on the committee.

*Engineering Council.* The President reported on the present status of the work of this body and the call it would soon make for funds to carry on work principally for the Government in the present crisis.

*American Institute of Architects.* Mr. Clyde R. Place and Prof. J. W. Roe were approved to represent the Society as honorary vice-presidents in a conference with the American Institute of Architects' Committee on Quantity Production.

*Machine Screw Nuts.* Messrs. E. H. Ehrmann, E. Burdsall and Charles Glover were approved as a Committee on Machine Screw Nut Standardization, to coöperate with a similar committee of the Society of Automotive Engineers. Announcements regarding this joint committee have already appeared in THE JOURNAL.

*Finance Committee.* It was voted to approve and authorize the budget recommended by the Finance Committee of two hundred and five thousand five hundred and five dollars, with the understanding that this sum shall include an appropriation of five hundred dollars for the Standing Committee on Public Relations, and, further, the Finance Committee is authorized to make such adjustments within this appropriation as may be required during the year to meet the extraordinary demands upon the engineering societies occasioned by the war.

*Second Liberty Loan.* The Finance Committee was authorized to invest the sum of ten thousand dollars ($10,000) in the Second Liberty Loan.

*Committee on Meetings.* On recommendation of this committee, Messrs. W. W. Bird, *Chairman;* Stanley G. Flagg, Jr., B. D. Fuller, Robert E. Newcomb, Charles E. Knoeppel, Wilfred Lewis and Richard Moldenke were approved as a Sub-Committee on Foundry Practice.

*Visits to the Sections.* The President reported that in response to invitations from the Sections, he had arranged to visit St. Louis, El Paso, Los Angeles, San Francisco, Seattle and Portland. An account of Dr. Hollis's trip will be given in the next issue of THE JOURNAL.

*Public Relations Committee.* Mr. C. T. Main, member of this committee, reported its organization meeting on October 11, with Dr. F. H. Newell as chairman and Mr. Morris L. Cooke as secretary.

*Constitution and By-Laws.* Prof. F. R. Hutton, as chairman of this committee, presented a report of suggested new by-laws for the government of the local sections. This was adopted, and the By-Laws are published in this issue of THE JOURNAL under Sections.

Professor Hutton also reported suggested changes in the by-laws to meet the constitutional changes announced in the October issue of THE JOURNAL and to be voted on at the Annual Meeting.

*Junior and Student Prizes.* Recommendations of the committees on Award of Junior and Student Prizes were accepted, and the awards made will be announced at the Annual Meeting.

*Committee on Sections.* The organization of the Connecticut State Section was approved, with headquarters at New Haven and branches at Meriden, Bridgeport, Hartford and Waterbury.

Mr. W. L. Roueche was appointed secretary-treasurer of the Birmingham Section.

Adjournment was taken to meet in Chicago on November 16.

CALVIN W. RICE,
*Secretary.*

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Those members who have not yet received Vol. 38 of TRANSACTIONS are notified that the delay has been caused by embargos on freight shipments to some points.

# ROLL OF HONOR

IN the May issue of THE JOURNAL we published the first list of members of the Society who have enlisted in the service of the country in its great drive "to make the world safe for democracy," and it is interesting to note the rapid growth of the Honor Roll. We have published notices of 566 members from all parts of the Union who have notified us of their enlistment. A large proportion of members listed are commissioned in the Engineer Officers' Reserve Corps or in the Ordnance Department, Officers' Reserve Corps. The Aviation Section of the Signal Corps, and the Naval Reserve, are also well represented.

If any members have joined the armed forces of the country, but have so far not been listed in the Roll of Honor, they are invited to send in their names to the Secretary. The Society is proud of their action and is anxious to apprise their fellow members of it. Further, the Society would be pleased to publish, and members at home would be interested to read, "experience letters" from men who are out on active service.

The following Roll of Honor supplements those already published:

ADAMS, C. E., 103rd Regiment Field Artillery, 26th Division American Expeditionary Forces.
ALLEN, JARED E., First Lieutenant, 26th Engineer Regiment, Camp Dix, N. J.
AMES, JOHN H., First Lieutenant, Ordnance Department, U. S. R.

BAIRD, LYMAN S., First Lieutenant, Aviation Section, Officers' Reserve Signal Corps.
BARKER, GEORGE S., First Lieutenant, Ordnance Department, U. S. A.
BATES, HARRY H., Officers' Training Camp, Ft. Myer, Va.
BESSE, E. E., First Lieutenant, Ordnance Department, Officers' Reserve Corps.
BOND, F. M., Captain, Inspector of Ordnance, St. Louis, Mo.
BOYD, HUGH M., Second Lieutenant, F. A. O. R. C., Camp Upton, L. I.
BOYER, FRED. Q., First Lieutenant, Second U. S. Engineers.
BRENNAN, E. M., First Lieutenant, 309th Engineers, Camp Taylor, Louisville, Ky.
BROWN, EUGENE L., JR., First Lieutenant, Engineer Officers' Reserve Corps.
BROWN, FRED W., Captain, Ordnance Department, Officers' Reserve Corps.
BURTON, W. DEAN, Aeronautical Mechanical Engineer, U. S. Signal Service, Fort Omaha, Neb.

CAMPBELL, E. D., Captain, Ordnance Department, Carriage Division, Washington, D. C.
CASSIDY, PERRY R., Captain, Coast Artillery, Officers' Reserve Corps.
CHAMBERLAIN, PAUL M., Ordnance Section, Officers' Reserve Corps.
CHRISTEN, A. B., First Lieutenant, Signal Corps.

DALLIS, PARK A., Engineers' Training Camp, Atlanta, Ga.

EICHENBERG, M. A., Inspector of Aeroplanes and Aeroplane Engines, United States Signal Corps.
ELLSWORTH, PERRY F., First Lieutenant, Signal Corps, U. S. R.

FARR, ROY S., Second Lieutenant, Co. 1, Engineer Reserve Officers' Training Camp, American University, Washington, D. C.
FELKER, GEORGE F., Captain, Ordnance Department, U. S. R., Camp Wheeler, Macon, Ga.
FOWLER, W. S., First Lieutenant, Ordnance Department, Carriage Division, U. S. R.

GAILLARD, D. P., First Lieutenant, Ordnance Officers' Reserve Corps, Division T. U. S. A.
GFRORER, ALBERT H., First Lieutenant, Officers' Reserve Corps, Ordnance Department.
GILBRETH, FRANK B., Major, Ordnance Department, U. S. A.
GILMAN, F. W., First Lieutenant, Engineer Officers' Reserve Corps, Reserve Officers' Training Camp, Ft. Myer, Va.
GITHINS, THOS. F., Plattsburg Training Camp.
GLENN, E. R., Officers' Training Camp, U. S. A., Oglethorpe, Ga.
GOETZENBERGER, R. L., First Lieutenant, Ordnance Department, U. S. R., American Expeditionary Forces.
GREGORY, W. B., Major, Engineer Officers' Reserve Corps, American Expeditionary Forces.
GUISE, H. B., Major, Ordnance Department, Officers' Reserve Corps.
GUITERAS, J. G., Lieutenant, 4th Engineers, Vancouver Barracks, Wash.
GUTHRIE, JAMES, Major, Ordnance Department, Officers' Reserve Corps, U. S. A.

HALE, HENRY A., JR., Captain, Engineer Officers' Reserve Corps.
HALL, KEPPELE, Captain, Ordnance Department, U. S. R.
HALL, QUINCY A., Captain, Engineers' Section, Officers' Reserve Corps.
HARRIES, GEORGE H., Major General, Headquarters 59th Depot Brigade, Camp Cody, Deming, N. M.
HEWITT, R. B., Captain, Engineers' Department, Fort Sam Houston, Texas.
HIRSCH, GUSTAV, Major Signal Corps, U. S. R.
HOLMAN, R. C., Captain, I. O. M. O. C., 53rd Ordnance Mobile Workshop (Light), British Expeditionary Forces, France.
HURXTHAL, A. O., First Lieutenant, Ordnance Department, Officers' Reserve Corps, U. S. A.

JURGENSEN, J. C., Major, Ordnance Department.

KAELIN, CHARLES G., Captain, Ordnance Department, U. S. R., Frankford Arsenal, Bridesburg, Pa.
KALEY, GEORGE B., First Lieutenant, Ordnance Department, Officers' Reserve Corps, U. S. A.
KENT, EDWARD R., Officers' Training Camp, Ft. Myer, Va.
KILPATRICK, JOHN D., Major, National Guard, N. J.

LACOMBE, C. F., Captain, Engineer Officers' Reserve Corps, U. S. A.
LARSEN, CHARLES, Captain, 26th Engineers, Camp Dix ,N. J.
LE FEVRE, C. D., Ordnance Officers' Reserve Corps.
LIPSNER, B. B., Captain, Ordnance Department, Motor Section, U. S. A.
LONGLEY, FRANCIS B., Major, Engineering Department, Signal Corps Aviation School, San Diego, Cal.
LONGSTRETH, CHARLES, Lieut. Commander, U. S. Naval Reserve Force.
LORD, HAROLD S., First Lieutenant, Engineers, U. S. R.

MACMASTER, R. K., First Lieutenant, Engineer Corps.
MALLORY, CHAS. K., Lieutenant, U. S. N., Bureau of Steam Engineering, Washington, D. C.
MANN, CARL P., Officers' Training Camp, Ft. Myer, Va.
MAY, O. J., Captain, Engineers' Division, U. S. A.
METZ, W. R., Captain, Quartermaster Corps, U. S. R.
MEIXNER, BERNARD A., First Lieutenant, Ordnance Department, Officers' Reserve Corps.
MICKLE, FRANK A., First Lieutenant, Ordnance Department, Officers' Reserve Corps.
MIDDLETON, NATHAN A., Captain, Engineer Officers' Reserve Corps, U. S. A.
MILLER, PHILIP F., First Lieutenant, Field Artillery Section, Carriage Division, Ordnance Department, U. S. R.
MISCH, ARTHUR A., First Lieutenant, Ordnance Section, Officers' Reserve Corps, U. S. A.
MYERS, J. L., First Lieutenant, Ordnance Department, Officers' Reserve Corps.

NIGH, G. W., Camp Funston, Fort Riley, Kan.
NORRIS, EARLE B., Captain, Ordnance Officers' Reserve Corps, Field Artillery Section, Carriage Division, Ordnance Department.

PRATT, PROF. JOSEPH HYDE, Major, Engineers, Separate Battalion, N. C.

RATHJENS, G. W., Major, 313th Engineers, Camp Dodge, Des Moines, Iowa.
RICHARDSON, EDWARD B., Major, American Expeditionary Forces, France.

SHORT, FRANK, First Lieutenant, Ordnance Department, U. S. A.
SMITH, HORACE L., First Lieutenant, 1st Regiment of Engineers, France.
STARK, W. E., Lieutenant, Company C, 5th Engineers, Corpus Christi, Tex.
STEPANEK, EMIL, Battery B, 333rd Field Artillery, Camp Grant, Ill.
STETSON, JOHN B., JR., Aviation Section, U. S. A.
STREETER, ROBERT L., Captain, Ordnance Department, U. S. R.
SUMMERS, DANIEL, First Lieutenant, Engineer Officers' Reserve Corps, Camp Meade, Md.

* Acceptance of commission pending at date of latest list from War Department.

SWAIN, P. W., Second Lieutenant, Field Artillery, Camp Devens, Mass.
SWIFT, HARLEY L., First Lieutenant, 16th Regiment Engineers, Engineer Officers' Reserve Corps.
SWETTING, J. R., Second Lieutenant, Engineer Officers' Reserve Corps.

TALBOT, J. A., Second Lieutenant, Field Artillery Section, Officers' Reserve Corps.
THOMPSON, P. W., First Lieutenant, Inspector of Ordnance, Ordnance Department, U. S. R.
TILSON, HOWARD, Ordnance Department, Officers' Reserve Corps.
TROWBRIDGE, AMASA, Major, Ordnance Department, Officers' Reserve Corps.

VINNEDGE, EARLE W., Second Lieutenant, 309th Engineers, Camp Taylor, Louisville, Ky.

WALKER, L. E., First Lieutenant, Ordnance Officers' Reserve Corps, Carriage Division.
WEBSTER, LAWRENCE B., Captain, Ordnance Department, U. S. A.
WELLING, LINDSAY H., Ordnance Department, Rock Island Arsenal, Rock Island, Ill.
WIELAND, C. F., Captain, Officers' Reserve Corps, U. S. A.
WILLIAMS, S. S., Signal Service, U. S. A., Atlanta, Ga.
WOODBURY, J. G., Major, Ordnance Department, U. S. R.
WRIGHT, DOUGLASS B., Second Lieutenant, Engineer Officers' Reserve Corps, United States Expeditionary Forces, France.

ZEIGER, N. A., First Lieutenant, Ordnance Department, U. S. R.

## Secretary's Letter

Have you subscribed for a Liberty Bond? If not, won't you please immediately telephone your bank offering to take a bond if not too late, or to subscribe to the next issue? Also arrange to pay for it out of future savings, not by selling investments or withdrawing moneys in savings banks,—both of which are required to continue, without embarrassment, the existing industrial conditions.

Then won't you take up the matter in your business relations? Get everybody saving and investing their savings in Liberty Bonds. Every member of your department should take a bond; if not, know why.

Only ten per cent of the face of a bond need be paid in. The bank will carry the balance at four per cent, the same as the Government pays. If your bank is unwilling to do this, notify me and I will advise you of a bank that will. Business is done on credit. The Government needs the credit of the people. Why not lend your credit to your Government?

Are you aware that to win this war, 10,000,000 people must subscribe for bonds, and that only by the combined energies of every man, woman and child we can win? If you can, take out a bond for every member of your family and instruct them to help pay for it out of sacrifices, candy, entertainments, clothing, everything that is unnecessary. Don't fear that you are going to put people out of employment if every one stops waste. The United States is starting on a rate of production that is going to require the labor of 10,000,000 people on war activities alone!

I know of factories going up where there are all manner of machine tools, lathes, planers, boring machines, etc., and not only now is every employee a woman, but no men are to be employed because there is no prospect that there will be any men for an indefinite period.

Come to the Annual Meeting and hear all about the employment of women in the industries and how the several problems have been met.

Every feature of our Annual Meeting is of vital interest to you. Learn how you can be of greater service to your country in this crisis. It is your duty to your profession to have it render the greatest service to the nation.

CALVIN W. RICE,
*Secretary.*

## A.S.M.E. Standards

SOON after its foundation in 1880, the Society instituted the procedure of creating standards of method and dimensional standards and of issuing such standards in printed form for general use. To date upward of fifty such standards, or codes, have been formulated, and some of them have been widely adopted and have become the basis of extensive manufactures.

The consideration of a proposed standard by the Society has usually been inaugurated as the result of its attention being called to diversities of proportions existing in similar pieces produced by different manufacturers; variances in methods of measurement of similar quantities; lack of a uniform basis of expression of certain facts; absence of interchangeability, etc.

Sometimes the absence of the standard, and the consequent necessity of it, has been pointed out by a competent authority in a paper embodying a resolution recommending the expediency of the Society considering the matter and reporting. Sometimes an interested party has addressed the Society requesting an opinion, which has later been made the basis of a standard. Sometimes the Society itself has recognized the necessity for a uniform procedure and has taken the initial step toward its creation.

In all cases, upon affirmative action by the Council of the Society, accepting the duty to formulate the standard, a committee of competent persons, members of the Society and other authorities, has been appointed to frame recommendations. Such committees have always been charged to take into their confidence all interested parties and to submit their findings to such parties for inspection and criticism before reporting them to the Society.

Reports of standards committees are presented at a general meeting of the Society and are, upon presentation, open for discussion by the whole membership and by others interested. Following such discussion, if, by vote, the recommendations still stand, the report is referred to the Council, who receive it and, upon approval by them, order it entered upon the record and printed in the TRANSACTIONS of the Society.

In cases where the field of action covered by a committee is very wide, viz., such as that of the Boiler Code Committee or the Power Test Committee, it has become the practice, on the acceptance of the committee's report and its subsequent discharge, to appoint a permanent committee to interpret the rules when called upon to do so, to make such revisions as may be found desirable, and to modify the rules to meet such new conditions as arise. These interpretations and rules are formally approved at meetings of the permanent committee, and by letter ballot submitted to the members who could not attend the meeting. They are thereupon submitted to the Council, and if approved printed in THE JOURNAL. The permanent committee holds meetings from time to time, at which all interested parties are given an opportunity to present suggestions with regard to the standards under consideration. These meetings constitute "revision periods" and take place at stated intervals, for instance, once in two or more years. All revisions of the codes or standards involving a change of meaning are reserved for these meetings, which may also take the character of "public hearings" so as to afford everybody interested an opportunity of stating his case in public.

Recent developments in the standardization work of the Society include the appointment, by amendment to the Constitution in the Spring of 1915, of the Standardization Committee as a standing committee of the Society. It is the function of this committee to standardize the method of making

and arriving at standards rather than create standards themselves. This committee endeavors to bring about a unification of the standardizing work of the Society, and for this purpose national and international coöperation between organizations and governments, including an exchange of information with regard to standardization.

Finally there is the Standardization Committee of the national engineering societies to coöperate by representation on a proposed Joint Committee composed of three representatives each from the national engineering societies, to consider and report back to their respective societies suggested means of bringing about coöperation in the formulation of American Engineering Standards.

The Society is at all times prepared to formulate standards within its field of activity and to assist other organizations in the preparation of standards, and will, upon request, appoint members to serve on committees for this purpose. Several such coöperative committees are at work at the present time.

It should be reiterated that none of the reports are adopted by the Society. They are simply actions which carry weight and a recommendation, but no further obligation. In practically all cases the standards have been accepted by outside parties, but of course without request by the Society.

## Catskill Aqueduct Celebration by Engineers

The completion of the Catskill Aqueduct is an event of such extraordinary engineering importance that, notwithstanding the war, the citizens of New York decided that it should not pass unobserved. As an engineering feat, the aqueduct is the greatest accomplishment of its kind in history and a monument to American genius.

To plan and carry out the arrangements for the commemoration, the Mayor of New York, Hon. John Purroy Mitchel, appointed a Mayor's Catskill Aqueduct Celebration Committee, with Hon. George McAneny as chairman and with various sub-committees. The Sub-Committee on Art, Scientific and Historical Exhibitions, Dr. George F. Kunz, chairman, in turn invited the United Engineering Society to appoint a committee to coöperate with it in planning the engineering features of the celebration. This committee consists of Messrs. Samuel Sheldon, Chairman; Charles Warren Hunt, Calvin W. Rice and E. Gybbon Spilsbury.

The celebration commenced on October 12 with appropriate exercises, such as turning on the Catskill water at new fountains in City Hall and Central Parks; emptying the lower Croton reservoir, now to be abandoned; civic parade; exercises in the public schools and exhibitions by the historical, scientific and art societies.

The United Engineering Societies Committee, working with Dr. Kunz's sub-committee, has planned an Aqueduct Celebration by engineers to be held in the Engineering Societies Building, New York City, on November 14. Mr. George H. Pegram, President of the American Society of Civil Engineers, will preside, and there will be addresses by Hon. John Purroy Mitchel and Major-General George W. Goethals. Mr. A. D. Flinn, deputy chief engineer of the Metropolitan Board of Water Supply, will deliver an illustrated lecture on the Catskill Aqueduct.

The Catskill Aqueduct Medal

## Power Test Hearing

A public hearing of the Rules for Conducting Tests of Power Plant Apparatus (Power Test Code of 1915) will be held in the Engineering Societies Building, New York, December 7, in connection with the Annual Meeting. The hearing will be conducted by the Power Test Committee, and the Advisory Committee of this Committee will attend.

## Condensed Catalogues

The Seventh Annual Volume of the A.S.M.E. Condensed Catalogues is the largest and most comprehensive edition of this book yet published. An endeavor has been made in the new volume to increase the value of this publication to the membership and to the mechanical profession at large. Many more firms than ever before are represented by publication of their data in the Catalogue Section.

The general Mechanical Equipment Directory, which was inaugurated as a new and distinctive feature in the 1916 volume, appears in this edition in enlarged and improved form. In its preparation the suggestions received from members and others, following the initial appearance of the Directory in the issue for last year, have been of much assistance. During the past year the Society's records relating to manufacturers of mechanical equipment have also been extended, with the result that in this edition the Directory contains the names and addresses of more than 3200 different firms, indexed and cross-indexed under upward of 2500 subject headings.

The section of Engineering Data has also been extended and improved in this volume. In addition to the data selected from The Journal and Transactions for the past year, a summary of the work of the standards committees of the Society is included this year.

# PRESIDENT HOLLIS ADDRESSES THE CLEVELAND ENGINEERING SOCIETY

On September 11, Dr. Ira N. Hollis, President of The Am.Soc.M.E., addressed the Cleveland Engineering Society on the subject of Engineering and Coöperation, in which he urged most earnestly that the engineers of the country come together for those interests which they hold in common. He expressed the hope that the Engineering Council would soon become representative of every engineering society in this country, local as well as national, making the council a body of men, in number between sixty and seventy, who can truly speak for the engineers of the country, and having power delegated to them to speak. Dr. Hollis said in part:

### ENGINEERING AND COÖPERATION

How can coöperation be applied to engineers in a special way so that they can be more able to serve the colors or to dedicate themselves to real service? How can the engineers best work together? We call this an age of specialization in connection with engineering and everything else; but what is specialization but coöperation?

There are various methods by which coöperation may be brought about, and I care not how it is brought about, whether through national engineering societies, local engineering societies, engineering clubs, or through colleges, so long as it is effective.

In the national societies we have made an effort during the past few years, by means of sections of the societies in various parts of the country, to interest groups of our men in what the national bodies want to do. The American Society of Mechanical Engineers, for example, has sections in a great many of the large cities all the way to California. That does not mean that the parent society is unfriendly to local societies. I have often said, in fact, I always say in a city like this, we desire every engineer to belong to one of the national societies, and, above all else, to his local society of engineers.

We have made many efforts to bring the societies together into what might be called a great national society, and they have always been failures. They have appeared in the form often of conference committees representing a number of societies.

We have had special conferences on all kinds of subjects, started for the purpose of elucidating some one subject in which all of the engineers are interested. I recently proposed in a letter to the chief engineering societies, the constituting of a council that would last for all time and recognize this condition of certain things common to all engineers as apart from the technical matters we want to study and work out in our own societies. The idea was threshed out for three or four months, and I thought it was going to fail. It did not, however, and we have now in the Engineering Council at least an attempt to solve questions among civil, mechanical, electrical and mining engineers of this country.

What are the kinds of questions common to engineers? The American Society of Mechanical Engineers was founded, and in the ideas of its founders was constituted, for the education of its members in technical matters by the interchange of papers, by reading papers for one another's education, and we have profited by that. It is truly an educational institution. Now, out of that society there have grown, as the result of experience, certain needs for a better understanding of the relation of that society to the public. The reading of a technical paper is a very good thing, but if we do nothing else than listen to technical papers and meet only to exchange views about machinery, we are narrowing our viewpoints a good deal, and depriving the members of our society of the opportunity to become really enlightened in the application of their profession to the great needs of society.

The way to solve our problem of coöperation in the United States amongst the engineers is not by establishing a new society for that purpose, but by making use of the agencies that already exist—all the national and local engineering societies.

It seemed to me that we might have a congress of engineers. I asked a year ago if it was not possible to take the four national societies that are rather concrete and within reach, so that getting them together would be practical at least, and see if we could not have one meeting, where all of us met. I have sometimes thought that it would be a good thing if we could extend this idea to the whole of the United States, and have one grand round-up at some place in this country where we could all get together and perhaps spend a week in threshing out one another's full ideas and bringing something out of the discussion that would be worth while. I have despaired of being able to carry out this plan through pressure of other work. I do not know of any other way to do it than to bring the societies face to face from month to month with the numerous problems that are common to them all, and that is what we propose to do through the medium of the Engineering Council.

My hope for the Engineering Council is that it is simply the beginning of a council backed by the engineering societies themselves, having power delegated to them to solve certain questions without any reference back to the societies at all, as engineers, and my hope is that every engineering society in this country, local as well as national, will in the course of a few years belong to the Council, making it a body of men, in number between sixty and seventy, who can truly speak for the engineers of the country, and having power delegated to them to speak.

To my mind, I think we have in the Council the greatest opportunity the engineers have ever had in the history of this country for all of us to get together. All of us ought to go to work to help it and strengthen it in every way, and if it does not broaden itself out so that other societies become members of it and have their voice—their voices are just the same as those of the men who are working in the Engineering Societies Building in New York—it should be made to.

I do not know of any better way, to begin with what I call real coöperation, than to take the agency which has gradually grown out of a necessity in New York City, and strengthen it into a truly national council that represents you engineers in Cleveland just as much as it represents the men in New York or the men in any other place.

In connection with the extension of representation on the Engineering Council, I appointed a committee, each of whose members represents seven or eight societies, for the purpose of seeing what can be done toward compiling a complete directory of all the engineers of the country. There are four types of engineers so far as their relation to the societies is concerned: those who belong to one or more national societies, those who belong to a local society and a national society, those who belong to a local society and do not belong to a national society, and those who belong to no society at all. All ought to come in our listing as part of the public service that the societies can do for the engineers. I think the directory, if compiled, ought to be in two places, one in the Engineering Societies Building in New York, being a complete list, and the other a local list for use in every locality; so that there are two places where we ought to have such a list, one that applies to Cleveland, we will say, and one that applies to the whole nation.

This committee has been putting in no end of time and study. For the purpose of the war they have already made out a first-class list of fifteen hundred or two thousand men who have intimate knowledge and great experience in specialties. That list is used by the United States Government; in fact, hardly a day goes by that we do not have some request in connection with it. But there is the after-war condition, where such a committee representing all the engineers could be of great use in connection with the readjustment of our industries.

We know as engineers why we ought to work together. There is, however, a last thought I want to put into your minds, that we gather strength just in proportion as we impress upon the other citizens of this country that we belong to a truly great profession interested in the welfare of this country. I sat down in Washington the other day to listen to Mr. Post, assistant to the Secretary of Labor, and other gentlemen speak on the establishment of what they call a public-service reserve, which would naturally belong to the army or navy. Mr. Post gave me a list of the positions that he proposed to fill, including plumbers, boiler-makers, blacksmiths, all down through all the trades. I said to him, "Why, Mr. Post, you misunderstood the situation; you must be thinking of engine drivers." "Oh, no," he said, "I am thinking of the engineer." "Well, but," I said, "the engineers

are professional men." "Oh, no," he replied, "they are wage earners." Now, that was a description that is totally false. We are wage earners in the sense that the lawyer and the doctor is a wage earner, but we are not wage earners in the sense that a man who goes to work ten hours a day for so much an hour is. We may have to go through that apprenticeship, and it is a good thing to go through it, but nevertheless when we talk of engineering we mean the profession involving the same amount of thought, the same interest in the development of our country that the lawyer or the doctor has.

Consequently, I emphasize the word *profession*, and I believe that in coming together as engineers (not necessarily in one great engineering society, which I think is a piece of Utopian foolishness) our national and local societies can cultivate the vocation peculiar to themselves just as well after they come together as they do now, and to come together for those things common to all and that relate to the public relations of the engineering societies. Do not let us surrender the fact that we are professional men, that whether we get our education in college, or whether we get it by the hard knocks of experience, we have learned a great profession without which our country would be an undeveloped and barren waste.

# WAR ACTIVITIES OF TECHNICAL SOCIETIES

By CALVIN W. RICE, NEW YORK

Secretary, The American Society of Mechanical Engineers

War is a science; in fact, it is one of the most complex of sciences. This has been recognized for ages, but in the present war it has become particularly evident. War in the air, war under the sea, war by means of novel surface machines, bombs and gases have all added to the complexity of the science.

War has become a matter of complete military and economic organization, into which every man, woman and child must be massed. The sole thought and effort of the nation in modern war must be concentrated on the business of making war. Particularly is this true in "our" war.

In this complete organization the technical men play not a small part, and it is, therefore, but natural that the several technical societies representing them should be active as such in the war period. It is, however, with no thought of taking peculiar credit that the following activities of the technical organizations are enumerated—it is realized that at this time the nation places dependence on everyone, no matter what his talent or connections.

It was during the Civil War in 1863 that the National Academy of Sciences was formed and Congress gave it a charter to advise the Government in all technical matters. Therefore, it was to be expected that with the war problems accumulating, as they did last year, the Academy should again offer its services, and the President of the United States officially received them in September, 1916. President Wilson invited the President of the Academy at that time to form what is known as the National Research Council. The Council has functioned continuously since its appointment and has performed excellent service.

The Council is a body of about 40 men, members of technical societies, who have in turn arranged themselves into numerous committees to study all realms of research. The following is part of a statement kindly prepared by the Vice-Chairman of the work of the Council to date, condensed with difficulty on account of the great variety and scope of its activities:

## BROAD WORK OF THE NATIONAL RESEARCH COUNCIL

All of the work of the National Research Council that touches upon Army and Navy problems is carried on with the advice, cooperation or control, as the case may be, of the representatives of the various Departments of the Army or Navy under which such work comes.

The Council has coöperated in the establishment and organization of the submarine experimental work at Nahant, Mass., and has also established a very active submarine station at New London, Conn., and another at San Pedro, Cal., and has been instrumental in the organization of groups working at New York, Chicago and Madison, Wis. There has resulted a great practical advance in the art of submarine detection which it is not desirable to go into further.

The Physics Committee of the council has distributed to various groups twenty or more large problems in physics, which are being actively worked upon and some of which have already been solved. Among the latter are the location of aircraft by sound, the development of fire control for anti-aircraft guns, telephoning between aeroplanes, protection of balloons from ignition by static charges, and development of new and improved methods of measuring muzzle velocities.

The Chief Officer of the Signal Corps of the Army has asked the National Research Council to act as the Division of Science and Research of the Signal Corps, and in this capacity the Council has organized a sound-ranging service in the Signal Corps, and a new meteorological service in the same corps, and is now drawing specifications for scientific instruments to be used on aeroplanes. It has sent a dozen of the best physicists in the country to France to aid the American Expeditionary Forces with their scientific knowledge, and is selecting a personnel of several hundred men who are to be engaged in the scientific services of the Army and Navy.

The Chemistry Committee has perfected an elaborate organization for handling all the chemical problems which arise in the Army and Navy, and it has distributed some 150 chemical problems which are being attacked in the chemical laboratories of the country.

The Engineering Committee has contributed in no small degree to the development of devices for the protection of ships from submarines. It has organized a large group which is now working on the development of steel protective devices for use of the soldiers at the front. Through coöperation with the National Advisory Committee for Aeronautics it has carried on extensive and important researches in the development of aeroplanes and aeroplane engines.

The Nitrate Committee has made an elaborate study and report which has been made the basis for the expenditure by the Government of large sums of money upon the erection of a nitrate plant and upon kindred projects.

The Gas Warfare Committee has had for six months 120 chemists working on the problems of gas warfare, and the results already obtained have been of the utmost importance—so important that the Army and Navy have placed large appropriations at the disposal of this committee for its researches.

The Optical Glass Committee, by taking from research laboratories like the Geophysical Laboratory a dozen or more silicate chemists and putting them directly in the works of the Bausch and Lomb Company and the Pittsburgh Plate Glass Company, has in six months' time developed in America the production of optical glass from nothing up to 20,000 lb. a month, and in two months more this figure will have been multiplied two or threefold.

The Foreign Service Committee, which the Council sent abroad at once upon the outbreak of the war, was wholly responsible for the sending back to this country of French, English and Italian Scientific Missions, which brought with them the contributions which science had made to the war, both in the matter of instruments and methods, and unquestionably saved months of time in putting the United States abreast of the European situation, as regards modern scientific methods in warfare. It is difficult to overestimate the stimulus to American participation in the war which resulted directly from the action of the National Research Council in sending abroad at once this Foreign Service Committee composed of seven of the best scientists in the country.

Abstract of address before the Southern Commercial Congress, New York, October 15, 1917. The author wishes to acknowledge his indebtedness to Mr. W. E. Bullock, Associate Editor of The Journal, for his assistance in the preparation of this paper.

### THE ENGINEERING FOUNDATION DONATES ITS INCOME

Just previous to the declaration of war by the United States, the American Society of Civil Engineers, The American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers were developing coöperative relations with the National Academy of Sciences through the Engineering Foundation, this latter being a group of men representing the above societies in the administration of funds devoted to the service of man through the instrumentality of the Engineer. The Foundation promptly placed its financial resources and staff at the disposal of the National Research Council, and these services have been continued until recently, when subventions have been received by the National Research Council sufficient to enable it to maintain independently the many and heavy demands which were fast exceeding the resources of the Foundation.

### THE NAVAL CONSULTING BOARD EXAMINES 200 INVENTIONS A DAY

In the preceding fall, in October, 1915, the Secretary of the Navy invited twelve engineering and technical societies to nominate two men each whom he might appoint on the Naval Consulting Board. The societies responding were the four previously mentioned and the American Chemical Society, American Mathematical Society, American Aeronautical Society, Inventor's Guild, Society of Automotive Engineers, American Society of Aeronautical Engineering, American Institute of Metals and the American Electrochemical Society.

You are all familiar with the great industrial census directed by the Committee on Industrial Preparedness, a sub-committee of the Naval Consulting Board, whereby all industries in the United States doing an annual business in excess of $100,000 were listed, together with all pertinent information as to their capacity, number of workmen, location with respect to sources of materials, transportation, etc. These data have all been collated on cards similar to those used in the United States Census.

Committees in each of the forty-eight states, the territories, and the District of Columbia were formed by the following five Societies: American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers and the American Chemical Society, who performed the work, assisted, of course, by the companies themselves. Much if not all the undertaking was without expense to the Government.

A first essential to all work to be done by the people generally must be publicity. To explain and popularize this census the President of the United States wrote a letter inviting the above five societies to undertake the work and the Associated Advertising Clubs of the World raised donations approaching one million dollars of advertising space throughout the press of the United States to display the President's letter and explain the census.

In the matter of inventions alone the Naval Consulting Board is receiving in excess of two hundred propositions a day which require for disposition the continuous voluntary services of a large number of the members of the technical societies.

### THE SOCIETIES' INFLUENCE ON WAR LEGISLATION

All these voluntary activities of the people of the nation were consummated in the establishment of the H. R. Bill 16,460, in July 1916, of the Council of National Defense composed of six members of the Cabinet and Advisory Commission of seven civilians.

The Advisory Commission has numerous committees with which the public is now familiar. The principal ones, however, of War Industries and Air Craft, are headed by men originally designated by the technical societies as their representatives in some war work.

The constant aim of all has been to uphold and strengthen the regular departments of the Government and enable them to meet the demands which have taxed them to the utmost.

The four engineering societies already mentioned as taking the industrial census, joined by the American Institute of Consulting Engineers, were active in the movement which resulted in the legislation providing for the Engineer Officers' Reserve.

The nation has by this legislation obtained and placed in military relation the services of thousands of the best men of the profession and augmented the staffs of every bureau of the Government.

### THE SOCIETIES AND MILITARY EDUCATION

Very early in the war, and sensitive to the needs of the national engineering societies, the Engineers' Club of New York formed a military engineering committee. The object of this committee was both to arouse the people to the necessity of preparedness and to instruct them in military tactics. The engineers in New York were duly prominent in the preparedness parade, which was the forerunner of similar parades all over the United States.

A series of military lectures was given in the Engineering Societies Building under the auspices of the committee. The lecturers were mainly men loaned by the War Department, but credit is due them for faithfully giving this course lasting several weeks when it is understood that the preparation and giving of the lectures was in addition to and outside of the strenuous work of an army officer preparing for war.

The same committee later supervised and financed the recruiting of a division of engineers for France.

### SPLENDID WORK OF THE S.A.E.

No one Society has had a more prominent or important part in war work than the Society of Automotive Engineers. It has not only furnished some of the most valuable volunteer men now in the departments of the Council of National Defense, but as a strictly technical work the Society has undertaken standardization of air-craft production, maintaining a suite of offices and a staff both in New York and in Washington.

The engineers who designed the wonderful Liberty Motor are members of the Society of Automotive Engineers.

The Society is also prominently represented on the Automotive Transport Section of the War Industries Board.

The American Railway Association, coöperating with the Chairman of the Advisory Committee of the National Council of Defense, has a Committee on Transportation consisting of 28 railway executives.

### THE AMERICAN MUSEUM OF SAFETY'S CONTRIBUTION

The American Museum of Safety has been coöperating with the Government to conserve the lives and health of workers in federal industries. It undertook a safety survey of federal plants, the director of the Museum being placed in charge of safety inspection work. As the result of this survey the Government placed an experienced safety engineer in each navy yard and arsenal, and a central safety committee has been organized in Washington for directing the Government's accident-prevention work.

The director of the Museum has been appointed chief safety expert of United States Employees' Compensation Commission. The trustees have released the director of the Museum to serve without cost to the Government as advisory safety engineer. Two of the thirteen safety engineers appointed by U. S. Employees' Compensation Commission were selected from the staff of the Museum.

### ACTIVITIES OF THE CHEMISTS

The American Chemical Society, in addition to participation in the Research Council and the Naval Consulting Board, has coöperated with the American Institute of Mining Engineers and the U. S. Bureau of Mines in the preparation of a census of chemists, metallurgists and mining engineers, for which there is a great demand.

The society was prominent in the movement to protect the needs of the Government for scientific and industrial work in the matter of platinum supplies.

The society has coöperated in the selective draft, in similar manner to that previously mentioned in connection with the Society for the Promotion of Engineering Education, and arranged that drafted chemists shall be assigned to their special work, for which the Government is in great need.

### THE ENGINEERING COUNCIL APPOINTS WAR COMMITTEES

The Engineering Council, representing the Civil Engineers, Mining Engineers, Mechanical Engineers and Electrical Engineers, has a War Committee of Technical Societies and also the American Engineering Service Committee.

This latter has collected already the classification data of several thousand professional engineers, and is continually extending its lists, and eventually plans to have catalogued 110,000 professional engineers and technical men.

This committee for months has been supplying all departments of the Government and the industries generally with the names and abilities of specialists in all lines. The service is entirely free and any department of the Government or any industry needing professional engineers may apply at the Engineering Societies Building, 29 W. Thirty-ninth Street, New York, and service will be enthusiastically rendered.

### THE SOCIETIES AND GOVERNMENT STANDARDS

In addition to the coöperation in the joint activities already mentioned, The American Society of Mechanical Engineers has committees coöperating with the Government in the matter of certification of gages, in an effort to ensure uniform production throughout the United States. The working out of the idea which is so obvious to all will nevertheless demand the greatest coöperation on the part of everyone.

The American Engineering Standards Committee, representative of several of the societies already mentioned, is assisting in an international as well as national service of standardization of all kinds, both for the period of the war and afterwards.

### THE VARIED BUT VITAL ACTIVITIES OF THE SOCIETIES

The American Railway Engineers' Association has published and distributed a manual of recommended practice to all the members of the railway regiments in France.

The National Machine Tool Builders' Association has coöperated with the Council of National Defense, the Air-Craft Production Board and in the production of the new Liberty Motor. A comprehensive list of all the machine tools in the United States ready for delivery was prepared and furnished the Government.

The National Electric Light Association, The Association of Edison Illuminating Companies, The American Gas Institute, assisted also by the American Water Works Association, the Illuminating Engineering Society and the American Society of Refrigerating Engineers have for months maintained an office and staff in Washington and have undertaken a comprehensive service for gas and electricity to the various cantonments regardless of commercial considerations on the one hand, and on the other have been the clearing house to assist municipalities and aid utility companies to secure the coal necessary for their operation. They have also rendered invaluable and timely engineering service to various government departments and the Council of National Defense.

The American Institute of Metals has coöperated with the U. S. Bureau of Standards in the preparation and inspection of nonferrous metals and has furnished many men for the Engineer Officers' Reserve Corps.

The American Institute of Architects is handling certain emergency work for the Government through its committees appointed by the President of the Institute. A war-service register has been created, comprising over 3000 names, giving qualifications of architects and draughtsmen. This register has been actively used by various branches of the Government service.

The Illuminating Engineering Society has laid out the lighting schemes for the aviation cantonments for flying by night, an absolutely new problem. The society has also prepared industrial lighting codes for the Welfare Section of the Labor Commission of the Council of Defense. It is also at work on some confidential matters.

The Society for the Promotion of Engineering Education has prepared in detail modifications of curricula for students in engineering to meet war conditions, and has worked out a just modification of the draft law so that students who have been drafted may be assigned to finish courses which will specifically prepare them for government service.

Special information has been furnished the departments of the Government, including lists of all books on the application of engineering to the war.

The National Society for Promotion of Industrial Education has trained several hundred electricians for the Navy in connection with the Electrical School of the New York Navy Yard; it has also done similarly for the Signal Corps and is now training men for Marine service.

The Franklin Institute up to date has recruited 721 men for the Aviation Service. Its secretary is a major on General Pershing's staff and the associate secretary is a lieutenant in the Signal Corps. Investigations have also been made by the Institute for the National Research Council.

The National Association of Master Steam and Hot Water Fitters has furnished engineers and draftsmen to lay out the steam work for power and heating to be done in connection with hospitals, officers' quarters, barracks and other buildings at the cantonments, as well as many other buildings already under construction and to be built for several branches of the service.

The National Association of Engine and Boat Manufacturers has turned over to the Government complete inventories of the members' factories and equipment in order to facilitate the work of the Council of National Defense. Practically all of the submarine chasers ordered have been built in the factories of the members of the Association. Recently an arrangement has been effected with the Society of Automotive Engineers whereby the members of the Association have become represented in that organization with particular reference to the formation of a new Committee on Marine Standards, whose work will undoubtedly prove of immeasurable assistance to the Government.

The American Electric Railway Association has a committee with representatives in the several military departments of the Government, who in coöperation with the Council of National Defense are preparing a comprehensive map of all the electric railways and their availability for war.

In the South, the Affiliated Technical Societies of Atlanta have assisted in the industrial census already mentioned and in recruiting an engineer regiment. So many of their members have gone to the front that they cannot hold meetings.

The President of the Engineers' Club of St. Louis is a major. The club has assisted in recruiting some of the railway regiments now in France, has purchased and presented regimental colors and is arranging to send every member at the front a Christmas gift. It has also contributed to the American Red Cross.

The Engineers' Society of Northeastern Pennsylvania has organized a company of engineers which has been accepted by the National Guard and is now in federal service at Camp Hancock. The President of the society is commissioned as a major.

The Florida Engineers' Society maintains a classification list of men available for special service, and over twenty per cent of its membership are at the front.

The returns from more societies throughout the country seem to point to over ten per cent on the average as being now with the colors.

The Engineering Society of the South has sent its secretary, treasurer and ten per cent of its membership to the front. It is furnishing technical data to the Government, and like other organizations has assisted in recruiting the railway regiments.

### THE SOCIETIES AND WAR RELIEF

The technical societies with their obvious professional work have not forgotten war relief.

The Engineers' Club of New York has for nearly three years been giving six hundred dollars per month to the suffering in all countries.

About $11,000 was contributed by members of all societies to what is known as the British Professional Classes War Relief, inclusive of artists and others as well as engineers.

Obviously the technical societies, as organizations of professional men, are not content, with this war on our country's hands, to let anything rest, and at this very moment the representatives of the societies are meeting in Washington to discover how they can serve in the tremendously essential work of the conservation of coal.

There is shortly to be held a conference of all the technical committees to see how they may be coördinated, and a permanent headquarters and staff, all at our expense, placed in Washington at the disposal of the Government.

The technical societies are ready and willing to consecrate every ability to make the Stars and Stripes the symbol of that nation whose citizens are capable of the greatest sacrifice and unselfish service to mankind.

# CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER DECEMBER 10, 1917

Below is the list of candidates who have filed applications for membership since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted.

*The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted.* All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by December 10, 1917, and providing satisfactory replies have been received from the required number of references, they will be balloted upon by the Council. Those elected will be notified about January 15, 1918.

*NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.*

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

**California**

TEASDALE, GEORGE W., Master Mechanic, Potrero Mining Co. of Mexico, Los Angeles

**Colorado**

MALLORY, WALTER F., Instructor, University of Colorado, Boulder

**Connecticut**

ARKISON, JOHN T., Superintendent, M. J. Daly & Sons, Waterbury

CUDLIPP, CHARLES W., Secretary and Manager, The Rogers Paper Mfg. Co., Inc., South Manchester

SCOTT, NELLIE M., President and General Manager, The Bantam Ball Bearing Co., Bantam

WEBB, THOMAS M., Process Engineer, Remington Arms U. M. C. Co., Bridgeport

**Delaware**

ACKART, EVERETT G., Supervising Engineer, E. I. du Pont de Nemours & Co., Wilmington

**District of Columbia**

WOODWARD, MARK R., Engineering Aid, Bureau of Yards & Docks, Navy Dept., Washington

**Illinois**

BAILEY, ROBERT W., Agent, Structural Steel and Machinery, Chicago

**Indiana**

BULL, EYVIND H., Engineer, Green Engineering Co., East Chicago

**Louisiana**

ROBERTS, THOMAS H., General Superintendent, Stern Foundry & Machinery Co., New Orleans

**Maine**

HARVEY, WALTER O., Mechanical Engineer, American Thread Co., Milo

**Maryland**

HUSS, HENRY, Second Vice-President, New York & Hagerstown Metal Stamping Co., Hagerstown

**Massachusetts**

ARNOLD, Arthur A., Mechanical Engineer and Development Manager, American Optical Co., Southbridge

CLARKE, JAMES C., Educator, Head of Coöperative Industrial Course, Hyde Park High School, Boston

EYRE, JOHN J., Engineer on Rifle Parts, New England Westinghouse Co., Springfield

PERKINS, PERCIVAL I., President, P. I. Perkins Co., Boston

SHUTE, FRANK A., Nightingale & Childs Co., Boston

**Minnesota**

HAWKINS, ROBERT D., Superintendent of Motive Power, Great Northern Railway, St. Paul

**New Jersey**

BENNETT, HENRY G., General Manager, International Arms & Fuse Co., Bloomfield

DONOVAN, JOHN T. L., Superintendent and Engineer, Equipment Division, Edison Lamp Works of G. E. Co., Harrison

**New York**

BATTIN, HAROLD T., Chief Engineer, Horace A. Staples, Cons. Engineer, New York

CONRAD, WILLIAM L., Industrial Engineer, with H. L. Gantt, New York

CORLEY, RALPH A., President, Young, Corley & Dolan, New York

CORY, RUSSELL G., Consulting Engineer, New York

EADIE, JOHN G., Consulting Engineer, Eadie, Freund & Campbell, New York

KIBELE, EUGENE, General Manager, Clark Bros. Co., Olean

LEYSON, DAVID J., Assistant Production Engineer, Savage Arms Corp., Utica

LLOYD, ROBERT MCALLISTER, Consulting Engineer, New York

LUDLUM, ALBERT C., President, New York Engineering Co., New York

MACDONALD, COLIN F., Boiler & Factory Inspector, Rochester

RAHILLY, THOMAS A., Mechanical Engineer, Bureau of Sewers, Brooklyn

STROHMANN, WILLIAM, Chief Estimator and Assistant Chief Clerk of Cost Department, R. Hoe & Co., New York

SWEETLAND, ERNEST J., Vice-President and Eastern Manager, United Filters Corp., Brooklyn

**Ohio**

NIKONOW, JOHN P., Member, Russian Commission on Inspection of Artillery Orders, at Recording & Computing Machines Co., Dayton

SPENGLER, WARREN D., Electrical Engineer, Firestone Tire & Rubber Co., Akron

**Pennsylvania**

BATES, ERASTUS N., JR., Assistant Professor Mechanical Engineering, Pennsylvania State College, State College

CHERRINGTON, GEORGE H., President, Brown & Zortman Machinery Co., Pittsburgh

HAMILTON, WALTER C., First Lieutenant, Ordnance Department U. S. R., Frankford Arsenal, Philadelphia

HEERING, ERNEST K., Designing Engineer, Wm. Cramp & Sons' Ship & Engine Building Co., Philadelphia

McKENZIE, JOHN C. S., Special Representative, Erie City Iron Works, Erie

PRESCOTT, PERLEY R., Operating Engineer and Engineer of Tests, Erie City Iron Works, Erie

PYLE, LEWIS M., Designing Engineer, Niles-Bement-Pond Co., Philadelphia

**Rhode Island**

HOUGH, EDWARD B., President, Wightman & Hough Co., Providence

**Washington**

CAMMACK, ALBERT, Professor of Steam Engineering, Washington State College, Pullman

**Australia**
WOOD, Arthur, Locomotive Designer,
Commonwealth Railways, Melbourne, Victoria

**England**
FRYER, Frederick G., Chief Mechanical Engineer,
Rowntree & Co., Ltd., York

FOR CONSIDERATION AS ASSOCIATE OR ASSOCIATE-MEMBER

**California**
FLAM, August, Mechanical Engineer and Designer, Los Angeles

**Connecticut**
ADISHIAN, Peter K., Tool Designer,
Pratt & Whitney Co., Hartford
NAUHEIM, S. Albert, Assistant Superintendent,
Autotyre Co., Oakville

**Illinois**
COLEMAN, William F., Assistant Manager,
Pyott Foundry Co., Chicago
SHEA, John R., Head of Production Methods Division,
Western Electric Co., Chicago

**New York**
ENNES, John G., Outside Superintendent,
Bayles' Shipyard, Inc., Port Jefferson
LANYI, Louis, Chief Engineer, Fan Division,
Green Fuel Economizer Co., Beacon

**Ohio**
EIFORT, Harry E., Charge of Machinery and Equipment of Dept., Babcock & Wilcox Co., Barberton

**Oklahoma**
CORNELL, Herman D., Vice-President and General Manager,
Higrade Petroleum & Gasoline Co., Tulsa

**Wisconsin**
SHERRETT, Charles S., Safety Inspector,
National Workmen's Compensation Service Bureau, Milwaukee

**Cuba**
SOLIS, Octavio, Engineer,
American Trading Co. of Cuba, Havana

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

**California**
BARE, Bert, Draftsman,
Skandia Pacific Oil Engine Co., Oakland

**Connecticut**
NASH, Douglas E., Mechanical Engineer and Treasurer,
Nash Engineering Co., South Norwalk

**Delaware**
GRIER, Alexander M., Sanitary Engineer,
E. I. duPont de Nemours & Co., Wilmington

**District of Columbia**
MASSEY, Mark F., Draftsman,
Ordnance Office, War Dept., Washington

**Massachusetts**
HAY, Delos R., Inspector,
Sanford Riley Stoker Co., Worcester
SAVEDOFF, Morris M., Mechanical Engineer,
New England Westinghouse Co., Springfield
SYMONDS, Ralph F., Works Manager,
New England Structural Co., Everett

**New Jersey**
CONSTABLE, John P., Chief Engineer,
Edison Laboratory, Orange
WALSH, Jeremiah A., Engineer,
E. H. Mumford Co., Elizabeth

**New York**
SPATES, Thomas G., Assistant Power Engineer,
New York & Queens Electric Light & Power Co., Long Island City
STONE, Joseph L., First Lieutenant, Ordnance R. C., U. S. A.,
Remington Arms Co., Ilion
STRUTHERS, Royden T., Chemical Engineering,
Borden's Condensed Milk Co., New York

**Oklahoma**
WILKE, Erwin L., Superintendent,
Continental Gas Compressing Corp., Lenapah

**Pennsylvania**
SCHUETTE, Robert W., Assistant Chief Engineer, Steam & Hydraulic Dept.,
Mesta Machine Co., Pittsburgh
SWINBURNE, James G., Jr., Salesman and Mechanic,
Brown & Sharpe Mfg. Co., Philadelphia

**Washington**
MOORE, Edward J., Moldloftsman,
J. F. Duthie Shipbuilding Co., Seattle

FOR CONSIDERATION AS JUNIOR

**Alabama**
WELLS, Eliot C., Mechanical Engineer,
Alabama Power Co., Birmingham

**Colorado**
ROSE, Ernest A., Engineer,
American Beet Sugar Co., Rocky Ford

**Connecticut**
NASH, Harold L., Designing Engineer,
Nash Engineering Co., Norwalk
WRIGHT, Abner M., in Manufacturing Engineers' Dept.,
Winchester Repeating Arms Co., New Haven

**Delaware**
KRUG, William F., Jr., Junior Engineer,
E. I. du Pont de Nemours & Co., Wilmington

**District of Columbia**
TREUHAFT, Alexander A., Draftsman, French Warfare Section, Gun Division,
Ordnance Department, Washington

**Illinois**
BARRY, Thomas J., Assistant Engineer, Centrifugal Pump Dept.,
Dayton-Dick Co., Quincy
REYMOND, Paul L., Head of Engineering Dept.,
Federal Sign System, Chicago

**Michigan**
WILBUR, Robert L., First Lieutenant O. R. C., U. S. A.,
Office of Inspector of Ordnance, Detroit

**New York**
BUNKER, Arthur H., Refrigerating Engineer,
American Ice Co., New York

**Ohio**
FILLMORE, Herbert W., Engineer on Time Study,
Cincinnati Milling Machine Co., Cincinnati
HUST, William, Draftsman,
The J. H. Day Co., Cincinnati
PERRIS, Norris, Sales Engineer,
The Baker-Dunbar-Allen Co., Cleveland
WUERTH, Edward A., Mechanical Draftsman,
The J. H. Day Co., Cincinnati

**Pennsylvania**
CHRISTIE, Wallace T., Assistant to President,
The Pneumatic Elevator and Conveyor Co., Philadelphia

**Rhode Island**
FULLER, Joseph O., Instructor in Mechanical Engineering,
Brown University, Providence

**West Virginia**
BERRY, Bernard C., Master Mechanic,
Potomac Light & Power Co., Martinsburg

**Wisconsin**
WILKINSON, John B., Draftsman,
Nordberg Mfg. Co., Milwaukee

## APPLICATION FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE

**Pennsylvania**
GREENE, Harris R., Sales Engineer,
Riley Stoker Dept., B. F. Sturtevant Co., Philadelphia

PROMOTION FROM ASSOCIATE-MEMBER

**Connecticut**
DAVIS, Edwin P., Superintendent,
Modern Manufacturing Co., Bridgeport

**Missouri**
DANIEL, Allan P., Designing and Consulting Mechanical Engineer,
Bituminized Road Co., Kansas City

**Pennsylvania**
CAHILL, Edward H., Mechanical Engineer,
Arthur Brock, Jr., Engineering Co., Philadelphia

PROMOTION FROM JUNIOR

**Maryland**

STUART, MILTON C., Mechanical Engineer, U. S. Naval Engineering Experiment Station, **Annapolis**

**New York**

DOW, BENJAMIN W., Mechanical Engineer, The Elbert Clarke Co., Rochester

HARTFORD, CLAUDE, Engineer, Contract Dept., New York Steam Co., **New York**

QUICK, RAY L., Instructor, Experimental Engineering, Sibley College, Cornell University, Ithaca

SUMMARY

| | |
|---|---|
| New Applications | 92 |
| Applications for change of grading: | |
| Promotion from Associate | 1 |
| Promotion from Associate-Member | 3 |
| Promotion from Junior | 4 |
| Total | 100 |

# NECROLOGY

## EARLE C. BACON

Earle C. Bacon was born on May 29, 1859. He served his apprenticeship with the Delamater Iron Works in New York. While there, though but twenty-one years old, he designed the Bacon trunk-cylinder hoisting engine, which had a patented connecting rod with an inside rod for taking up the wear on brasses. This engine was the first used in New York for lifting brick, etc., in building construction. The same engine is still being manufactured for use as a winze hoist and for surface work around mines.

Mr. Bacon served as consulting engineer and furnished machinery for a great many mining companies, as he made a specialty of mining and quarry work.

He was at different times consulting engineer for the Davis Sulphur Ore Co., the Sulphur Mining & Railroad Co., Virginia, the Nichols Copper Co., the Lavonia Salt & Manufacturing Co., the Bristol Copper Co., and many others.

Mr. Bacon was also a pioneer in the asbestos field in Quebec, being employed as consulting engineer in that line, and designing and equipping the first mill for the reduction of asbestos in that region.

He was a member of the Union League Club and of the Machinery Club. He became a member of the Society in 1885. He died on April 9, 1917.

## WILNER E. JOHNSON

Wilner E. Johnson was born on May 16, 1881, in Sweden. In 1903 he began his apprenticeship with the Brooklyn Rapid Transit System as a draftsman in the 52nd St. shop of the System. He held successively the positions of chief draftsman in 1907, engineer of car equipment in 1911, and engineer of car construction for the allied New York Municipal Railway Corporation in 1913.

In 1912 Mr. Johnson made a country-wide study of car designs in relation to speed of passenger interchange, the direct result of which was the development and adoption of the center-entrance type of car, which has since become a model for many other roads. Mr. Johnson's most noteworthy achievements for his company were the detailed working out and development of the Brooklyn center-entrance surface car and the New York Municipal Subway car.

As a member of the committee on equipment of the American Electric Railway Association, he spared no effort to make the committee's researches and standards of real value and of active interest to the industry at large.

Mr. Johnson became a member of the Society in 1914. He died on July 27, 1917, at his home in Brooklyn.

## ALFRED EUGENE KENRICK

Alfred E. Kenrick was born in Brookline, Mass., on February 15, 1851. He was educated in the public schools of that town, and started his apprenticeship at the age of sixteen. In 1885, having learned his trade, he entered into partnership with his father in the firm of Kenrick Bros.

His most successful piece of engineering work is considered to be his invention of the water-heating system for the Brookline Public Bath House.

Mr. Kenrick was an active member of a number of societies in connection with his work. In January 1907 the American Society of Heating and Ventilating Engineers presented him with a silver loving cup in token of his services to that society. He held during his membership in the Master Steam and Hot Water Fitters' Association of the United States every office within its gift, and on the twenty-fifth anniversary of the Association, in 1913, he was presented with a silver pitcher and salver in appreciation and recognition of his fidelity. He was a member also of the Master Plumbers' Association of Boston.

ALFRED E. KENRICK

For over twenty years he served the town of Brookline on its appropriation committee, and for nearly thirty years he was associated with the Brookline Savings Bank, as a member of its board of investment and also as vice-president.

He became a member of the Society in 1896. He died at his home on January 17, 1917.

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With the assistance of leading professors in technical schools, business men and social workers, the Advisory Committee for Industrial Service Movement of the International Committee of Young Men's Christian Associations, has prepared a comprehensive outline of suggested college courses on the Human Side of Engineering. The courses are intended to be supplemented by engineering trips to study certain industrial conditions and the betterment work of selected companies.

# AMONG THE SECTIONS

IMPORTANT additions to the By-Laws of the Society pertaining to the government of the Sections were passed at the meeting of the Council on October 12. The Sections have now been in existence about ten years, and their activities have extended continuously and uniformly until they now constitute one of the major activities of the Society.

The Committee on Constitution and By-Laws has been working with the Sections Committee for about two years in drawing up suitable By-Laws to cover all the phases of the Sections' work to be found in different parts of the country, to afford the Sections every opportunity to carry on activities of local interest, and at the same time ensure that their procedure be conducted in uniformity with the Constitution of the Society, and the report presented by the former at the October Council meeting represents the consummation of these efforts. The new By-Laws which go into effect immediately are printed below:

## New By-Laws Governing Sections

B48 COMMITTEE ON LOCAL SECTIONS:

The Committee on Local Sections shall consist of five Members, Associates or Associate-Members. The term of office of one member of the Committee shall expire at the end of each Annual Meeting.

It shall be the duty of the Committee to confer with the officers and members of the Local Sections, and to consider, and make recommendations to the Council upon all matters affecting the welfare of the Local Sections. It shall confer with the Finance Committee as to the appropriation for the expenses of Local Sections in each annual budget of the Society, and shall determine the portion of that appropriation which shall be allotted to each Local Section. The Committee shall have such other duties as may be given to it by the Council.

B49 LOCAL SECTIONS:

*(a) Formation of a Section*

When a number of the membership of The American Society of Mechanical Engineers in any territory desire to form a Local Section, a preliminary meeting shall be called and notice sent to the entire membership of the Society residing in that territory. At this preliminary meeting a petition for the formation of a Local Section, containing suggestions as to the territory to be included in the Section, shall be presented, and if adopted shall be sent to the Committee on Local Sections for presentation to the Council with its recommendation. This petition shall be signed by such of the membership of the Society residing in the territory as favor the formation of such Section.

If the formation of a Local Section be approved by the Council, a meeting of the signers of the petition shall be held for organization and to elect a Local Committee of at least five from among the Section members. This Local Committee shall have charge of and be responsible for the proceedings of the Local Section.

*(b) Territory of a Section*

The territory of a Section shall include the locality naturally tributary thereto.

*(c) Name of a Section*

A Section shall be known as The (name of place) Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

*(d) Membership of a Section*

All members in every grade of the Society residing in the territory of a Local Section shall be Section Members of that Local Section. A member of the Society shall be entitled to vote or hold office in one Local Section only.

Any other person interested in engineering may be invited by the Local Committee to join its Section as a Local Member, but he shall not have the right to vote or hold office. Such Local Member shall pay dues to the Section not to exceed $5.00 per annum, which shall be due and payable in advance on October 1 of each year of his enrollment. Local Members shall not be considered in the allotment of expenses to the Section.

Members of Student Branches living in the territory of a Local Section shall be entitled to receive notices of and to attend all meetings of that Section for the period of two years after graduation. Such graduates shall be counted as members of a Local Section in the consideration of the allotment for expenses of that Section.

*(e) Activities of a Section*

The principal activity of a Local Section shall be the holding of meetings for the presentation and discussion of papers relating to engineering and to the allied arts and sciences; it may also hold meetings for social intercourse.

*(f) Meetings and Papers of Sections*

The provisions of the Constitution, By-Laws, and Rules of The American Society of Mechanical Engineers, and the precedents of the Society with respect to professional sessions for the discussion of papers, shall govern the procedure of the Local Sections, except that no meeting of a Section shall be considered a meeting of the Society as a whole.

Papers read before a Local Section shall be submitted to the Committee on Publication and Papers of the Society for possible publication in THE JOURNAL. The Committee on Meetings of the Society may select from among the papers presented before the Local Sections any paper for presentation before meetings of the Society. A Local Section shall not publish or permit to be published under the authority of the Section any paper as presented before that Section in whole or in part without first obtaining the approval of the Committee on Publication and Papers.

*(g) Coöperation of Local Sections*

A Local Section of the Society may arrange to hold joint meetings with other local engineering organizations, and may invite members of such organizations to attend its meetings.

A Local Section may affiliate with existing local engineering organizations, or form jointly with them new local engineering organizations, but the plan of such affiliation or organization, and the obligations assumed by the Local Section and the Society thereby, shall first be approved by the Council.

A Section may take action in any undertaking having the approval of the Council, and may coöperate in such action with any other local organization.

*(h) Delegates of Sections*

Each Local Section shall have the privilege of representation at the Annual Meeting of the Society by one official delegate. Such delegate, the chairman, if possible, may have such portion of his expenses for transportation to the meeting refunded by the Society as the Committee on Local Sections may direct.

*(i) Management of Sections*

All Local Sections shall be managed in conformity with the Constitution, By-Laws, and Rules of the Society.

Each Local Section shall be managed by a Local Committee of at least five members, consisting of a Chairman, a Secretary,

and such other officers as may be found desirable. Such officers shall be elected by ballot from the membership of The American Society of Mechanical Engineers who are members of the Local Section. They shall be elected before June 1 of each year, and shall take office on July 1.

The Chairman of each Local Section shall receive notices and have the privilege of attending all meetings of the Committee on Local Sections.

The Secretary of each Local Section shall report the Proceedings of that Section to the Secretary of the Society. He shall discharge the duties of Secretary of the Section, and shall perform such other duties as may be prescribed by the Local Committee.

*(j) Appropriation for Sections*

Appropriation by the Council for the use of Local Sections shall be used for expenses incurred in holding their professional meetings.

Expenditures chargeable to the Society for purposes of any Local Section must be provided for in the annual budget approved by the Council. No liability otherwise incurred shall be binding upon the Society.

An allotment for a Local Section may be drawn by its Committee as desired, provided that not more than one-half of the total yearly allotment shall be drawn between October 1 to February 1, and that an itemized account of its expenditures during that period shall be rendered to the Secretary of the Society before the remaining amount of the appropriation can be drawn, and provided also that the remainder of the allotment shall be drawn only during the remaining half of the fiscal year, and that an accounting of the second half shall be rendered at the end of the fiscal year.

*(k) Stationery for Sections*

All Sections shall use only such uniform stationery as shall be supplied by the Secretary of the Society.

*(l) Disbanding of a Section*

The Council of The American Society of Mechanical Engineers may, on sixty days' notice, suspend or disband any Local Section.

## Our Present Sections

The Society has now a Connecticut State Section, with branches at Bridgeport, Hartford, Meriden, New Haven, and Waterbury. It also has a Minnesota Section, with meetings held alternately at St. Paul and Minneapolis. Sections are also established in the cities of Atlanta, Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Detroit, Erie, Indianapolis, Los Angeles, New Orleans, New York, Philadelphia, St. Louis, San Francisco, Toronto (Canada) and Worcester. The Providence Engineering Society is affiliated with our Society, and its monthly meetings are reported in The Journal with the Sections' reports. The geographical distribution of the Sections is strikingly shown on the accompanying map.

## This Year's Work

Two events of importance have started off the Sections' work this year. At the time of going to press, President Hollis is visiting the Sections at St. Louis, Los Angeles and San Francisco, and is also speaking on behalf of the Society at El Paso, Seattle and Portland. At the same time the Committee on Sections is visiting St. Louis, Milwaukee, Chicago and Detroit, to meet the Executive Committees personally and discuss ways and means for Sections' development. Accounts of both these events will be given in the next issue of The Journal.

Below are published some of the plans of the Sections for their work for the coming winter. In common with the other activities of the Society, the Sections have in some cases experienced difficulties at this time on account of committee members, speakers, etc., being called into active service, in consequence of which all have not been able to send in their programs. However, those missing from this issue we hope to publish in the December number. Reports of the first meetings of some of the Sections for the new season are likewise here included.

The Committee on Sections is alive to the opportunities and possibilities of the Sections, and has under consideration means for developing these and making them available to the membership to the fullest degree. The Sections' organization can be made one of the strongest, if not the strongest, element in the life of the Society, for through it the benefits of the Society can be distributed to every individual member, wherever resident. Prospects at the present time for such development are exceedingly bright; there is work to be done, and the Sections Committee and the Executive Committees are ready and eager to do it. With the new By-Laws in force, providing unity and organization for this activity, great and far-reaching results may be looked for.

# SECTIONS REPORTS

### BALTIMORE

Plans for the coming year are now in progress and it is expected to hold the first meeting of the season early in November, the exact date to be announced later.

A. G. Christie,
*Section Chairman.*

### BOSTON

A most successful meeting was held on October 11, at which it was expected Captain Amann, who has recently returned from Verdun, would speak, but he was called away and Lieutenant Morize substituted most acceptably. Major Edwin T. Cole, Commandant at Massachusetts Institute of Technology, was our guest of honor.

Lieutenant Morize contrasted the differences between the present methods of warfare and those in vogue only a few years ago. He spoke for over an hour to an audience that listened breathlessly to his every word, and at the conclusion of his address answered a number of questions. Major Cole followed with an informal talk on the same subject.

Both speakers were enthusiastically applauded and the thanks of meeting voted them at its conclusion.

Lieut-Colonel L. Rees, V.C., M.C., of the Royal Flying Corps, who has recently arrived from England to assist with our aviation work, was the speaker at a meeting on October 25 which was similar to the one held on the 11th. A full account of this meeting will appear in a following issue of The Journal.

W. G. Starkweather,
*Section Secretary.*

### BUFFALO

The sixth season of the Engineering Society of Buffalo and affiliated branches was opened at the Hotel Statler, on October 10, with 125 members participating. After dinner Mr. Geo. W. Dunham, Mem.Am.Soc.M.E., president of the Society of Automotive Engineers, read an interesting and timely paper on the Internal Combustion Engine and the War, laying special emphasis on the functions and work of the automotive engineer in the great war.

David C. Howard, Mem.Am.Soc.M.E., chairman of the military-affairs committee and vice-president of the Chamber of Commerce, announced plans under way for the organization of engineers in wartime so as to increase their usefulness. Mr. Howard also asked the members to help the government catalogue the various war orders which have been placed in Buffalo and vicinity, and to offer assistance to the manufacturers filling these orders.

Industrial Production was the subject of a paper given by Wm. M. Dollar, Mem.Am.Soc.M.E., at the meeting on October 31. Mr. Dollar said that the essentials of modern industrial production,

such as shop-order and cost systems, planning and routing systems, piece-rate, premium and bonus systems, welfare work, etc., which have been worked out satisfactorily in larger shops and factories, have proved too cumbersome and costly for the small and medium shops, which, in the aggregate produce a very large portion of the total output of the country. The speaker, who has made a lifelong study of this subject, pointed out the advantage of such systems to these smaller shops and the benefits to be derived without material addition to the clerical work in shop or office.

LOUIS J. FOLEY,
*Assistant to Section Secretary.*

### CHICAGO

As THE JOURNAL goes to press we would make mention of the visit of the Committee on Sections to this Section on October 24. There will be a luncheon with the Executive Committee and a dinner with representative members present to discuss plans for meetings and coöperation for the coming season; details will be given in the next issue.

Chicago has decided to devote its meetings this year to the discussion of timely subjects, giving predominance to topics likely to bring out valuable information in connection with the war. At this date the following speakers and subjects can be announced:

*November 16.* Cantonment Construction, by Major P. J. Junkersfeld.

*January 18.* Airplane Engineering, speaker to be announced.

*March 15.* Engineering Problems of the New Union Terminal, by G. W. Hibbard.

*May 17.* Progress of the Shipbuilding Program of the United States, speaker to be announced.

A. D. BAILEY,
*Section Chairman.*

### CONNECTICUT (*Hartford Branch*)

At a meeting attended by men eminent in the profession and prominent in work closely affiliated with the engineering world, the Hartford Branch of the Connecticut Section was organized in the assembly hall of the Insurance Institute on September 28. The local branch will be one of five in the state. Bridgeport, New Haven, Meriden and Waterbury are the other Branches which compose the Section, and members of the Executive Committee of each were present.

The officers elected are as follows: B. W. M. Hanson, *chairman;* Hiram P. Maxim, *vice-chairman;* Sherwood F. Jeter, *secretary-treasurer;* M. D. Church, *chairman* Membership and Acquaintanceship Committee, and C. L. Grohmann, W. H. Honiss, C. D. Rice, A. D. Risteen, C. H. Veeder, members of the Executive Committee.

Mr. Jeter officiated as temporary chairman, and after a brief address introduced President Hollis. Dr. Hollis, in his talk, impressed the necessity for coöperation and sustained interest for the growth and success of the local branch; he advocated regular meetings and fusion of mechanical, civil, mining and electrical engineers, the main point being for the members to meet and exchange ideas. He brought before the audience the great part being played in the war by the engineers and pointed out the important work there would be for the engineer in the work of reconstruction after the war.

Past-President Jacobus followed with an address on the necessity of petitioning local representatives in Congress in order to bring about good results for the engineering profession. He said there was a time when the national body instructed its members to abstain from politics, but politics are conducted differently now and the individual politician must be reached and convinced.

Secretary Rice spoke of the importance to a municipality of an organization such as this branch. As citizens its members could demand efficient service. In a number of cities, he said, improvements in city streets, water supplies and other important things have been brought about by such organizations as the present one. Ernest Hartford, secretary of the national Committee on Sections, called attention to the numerous desirable opportunities for publicity the Sections have through the columns of THE JOURNAL and the medium of the technical press. F. R. Low, Mem.Am.Soc. M.E., editor of *Power*, told the gathering that owing to new discoveries and great achievements of the engineering profession the world was becoming a better place to live in. P. B. Morgan, chairman of the Worcester Section, told of the work of organizing that Section and hoped that the Hartford Branch would profit by its experience; he also conveyed an idea of some of the problems that might confront the newly organized branch. Henry B. Sargent, of the Executive Committee of the Connecticut Section, described the work already accomplished in the state by the New


GEOGRAPHICAL DISTRIBUTION OF A.S.M.E. SECTIONS

Haven Section which now becomes a Branch of the Connecticut Section.

H. B. Sargent,
*Section Chairman.*

## DETROIT

A meeting was held by the Sectional Committee of this Section early in October and officers of the Executive Committee were designated. The chairman was authorized to solicit papers for future meetings and suitable for publication in The Journal.

On October 25 a Dinner-Smoker was held at the Board of Commerce, at which the guests of the evening were the national Committee on Sections. A few select, brief papers were presented on timely topics, including a discussion on Problems of Shop Management by Messrs. Walter Rautenstrauch and D. Robert Yarnall. The plans were formulated for a party to attend the Annual Meeting in New York.

G. W. Bissell,
*Section Chairman.*

## LOS ANGELES

A dinner was arranged by the Section with the Joint Technical Societies on October 23, on which occasion President Hollis and Dr. George E. Hale addressed the meeting. Dr. Hollis addressed the student branch at Throop Polytechnic while in this city. A full account of Dr. Hollis's visit will be given later.

As for the plans of the Section for the year, the Joint Societies will meet at luncheon every Thursday noon and enjoy a short talk, the speaker for the day being furnished by the various societies in accordance with a pro rata list extending through the year.

Francis G. Pease,
*Section Chairman.*

## MILWAUKEE

On October 3 an illustrated lecture by Chester A. Lucas, Mem. Am.Soc.M.E., on the Manufacture of a 9.2 High-Explosive Howitzer Shell, attracted the largest and one of the most interested audiences we have ever had, there being over a thousand present.

With the aid of an actual shell and of lantern slides showing drawings, Mr. Lucas described very fully all the parts of high-explosive shells and also all the machine operations necessary to produce them.

He supplemented this description by motion pictures of the complete process of shell making. The different methods were then shown.

The members of the Committee on Sections arrived at Milwaukee on October 23 and were met by the local committee; luncheon was served at the Milwaukee Club and a visit to the Allis-Chalmers plant made in the afternoon. In the evening a large number of interested local engineers were present at a dinner and took part in a discussion of Society matters. A full account of this visit will appear in the next issue of The Journal.

Fred H. Dorner,
*Section Secretary.*

## NEW ORLEANS

Notes on Shipbuilding was the subject of an interesting paper read by F. J. French on September 7. The speaker illustrated his lecture with lantern slides showing construction work on tank steamers now being built for the Mexican Petroleum Company, of which he is engineer. These are the only steel vessels being built in New Orleans and the paper was received with much interest and caused considerable discussion.

The Section has planned only two technical papers for this year and has appointed a committee to arrange for monthly visits to various industrial plants.

H. L. Hutson,
*Section Chairman.*

## NEW YORK

At the opening meeting of the New York Section on October 16, Dr. T. Kennard Thomson, Mem.Am.Soc.M.E., delivered an address on The Evolution of Manhattan from an Indian Village to a Great Metropolis, contrasting by means of colored lantern slides the early conditions on the island with those now existing. In connection with his address he spoke of the congested port facilities of the City of New York and described a novel plan for relieving this condition, the essentials of which included filling in the present East River and replacing it by a new channel through Long Island, extending Manhattan Island and constructing three new islands in New York Bay.

A. D. Blake,
*Section Secretary.*

## PHILADELPHIA

The following interesting program has been arranged for the coming season by the Philadelphia Section:

*October 23.* The War's Effect on Merchant Shipbuilding, by Homer L. Ferguson, President and General Manager of the Newport Drydock and Shipbuilding Company. Joint meeting with the Engineers' Club in Witherspoon Hall.

*November 27.* Program to be arranged and include a visit by the national Committee on Sections. Meeting at Engineers' Club.

*December 11.* Offensive Against the Submarine, by Jos. A. Steinmetz. Joint meeting with The Franklin Institute.

*January 22.* Our Navy and the War, by Prof. Wm. L. Cathcart, U.S.N. (retired). Joint meeting with The Illuminating Engineers' Society will probably be arranged.

*February 26.* Supplement to Taylor's Art of Cutting Metals, by Carl G. Barth, Mem.Am.Soc.M.E.

*March 26.* Recent Developments in Material Specifications, by Dr. S. W. Stratton, Mem.Am.Soc.M.E., Director of U. S. Bureau of Standards.

Tentative program for the following:

*April 23.* Major W. P. Barba, Mem.Am.Soc.M.E., and Major A. S. Cushman.

*May 28.* George Satterthwaite and Professor Henry M. Howe.

*June 25.* Admiral Taylor and Chester Larner.

## PROVIDENCE

The Power Section held an interesting meeting on October 10, at which Professor Dean A. Fales, Mem.Am.Soc.M.E., gave a most interesting talk on The Gasoline Engine, with Particular Reference to Aeronautics.

Professor Fales is in charge of the instruction work in gasoline engines for both the Army and Navy Ground Schools of Aeronautics in Massachusetts Institute of Technology. He described the special problems arising in the design of the aeroplane engine and the present practice in solving these problems. His descriptions of the best types of engines used by the British, French and Germans were extremely interesting.

The Army Cantonment at Ayer, Mass., was the subject of an illustrated lecture given on October 16 before the Providence Engineering Society by F. A. Barbour, who was the supervising engineer in charge of construction of this work.

Mr. Barbour gave a most interesting account of the engineering problems which had to be met to complete this camp within the schedule time. The contract for the camp included 662 buildings to be completed by September 1 and actually ready several days before that time, in addition to 124 buildings, including a 100-bed hospital unit costing $500,000, refrigerating plants, storehouses, bakeries and miscellaneous buildings. The completion of this $6,000,000 contract necessitated a force of 9000 men, a weekly payroll of $400,000, the delivery of 30,000,000 ft. of lumber, the unloading of 50 carloads of material daily and the building of a complete sewerage system with 20 miles of pipe.

James A. Hall,
*Correspondent.*

## ST. LOUIS

The first fall meeting of the Section, held on September 21, was attended by about forty members. The early part of the evening was given over to a dinner, after which a great deal of enthusiasm was aroused by the speakers of the evening.

Judge Thomas L. Anderson, of St. Louis, delivered a very stirring address upon the subject of patriotism, and the remarks he made were very pertinent to the work and requirements of the mechanical engineer in the war.

R. L. Radcliffe, Mem.Am.Soc.M.E., chairman of the Section, brought very forcibly before the members the work which is anticipated by the Membership and the National Sections Committee during the coming year. A committee to arrange for the preparation of technical papers which could be published in The Journal and a committee on research work were appointed. The committee on program reported the schedule of dinners and papers for which arrangements have been made.

Topics of vital interest to mechanical engineers in St. Louis were then discussed by Messrs. J. Hunter, Mem.Am.Soc.M.E.; L. Gustafson, Mem.Am.Soc.M.E., H. R. Setz, Mem.Am.Soc.M.E., and G. R. Wadleigh, Mem.Am.Soc.M.E., all of whom indicated very clearly to the membership that there was a large amount of work laid out for the coming year and that it was to be carried forward with great earnestness. Indications are that the Section is on a very strong footing and that the work which may be expected of it during the coming year will be of great value to the Section as well as to the Society.

On October 22 a meeting of the Section was held at which Mr. John Hunter, Chief Engineer, Union Electric Light and Power Co., presented a very interesting paper on the recent improvements at the Ashley Street power plant of his company. The progress of the work was shown by lantern slides. The guests of the evening were the members of the Committee on Sections.

The Journal goes to press as the meeting is being held and a complete report will be given in the December issue.

### SAN FRANCISCO

M. M. O'Shaughnessy spoke at the regular bi-monthly meeting on October 16 on the subject of The Tunnels of San Francisco. The speaker described the general features of tunnel construction and the methods of payment therefor, illustrating his remarks with stereopticon views.

On October 25 a joint meeting of mechanical, civil, electrical, mining and chemical engineers, was held with Dr. Ira N. Hollis, Pres.Am.Soc.M.E., as the speaker and guest of honor. Full reports of these meetings will appear in the December issue. The following day it was expected that Dr. Hollis would address the student members either at the Leland Stanford Jr. University or the University of California, and the next day leave for Seattle where he would address the members of the Society in that city on the 29th.

B. F. Raber,
*Section Chairman.*

## STUDENT BRANCHES

The Society has now affiliated with it forty-five Student Branches, which are independent organizations of students in the following educational institutions:

Armour Institute of Technology................Chicago, Ill.
Bucknell College............................Lewisburg, Pa.
Carnegie Institute of Technology............Pittsburgh, Pa.
Case School of Applied Science..............Cleveland, Ohio
Colorado State Agricultural College.......Fort Collins, Colo.
Columbia University..........................New York
Cornell University...........................Ithaca, N. Y.
Georgia School of Technology..................Atlanta, Ga.
Johns Hopkins University...................Baltimore, Md.
Kansas State Agriculture College..........Manhattan, Kan.
Lehigh University......................So. Bethlehem, Pa.
Leland Stanford, Jr., University....Stanford University, Cal.
Louisiana State University...............Baton Rouge, La.
Massachusetts Institute of Technology.....Cambridge, Mass.
New York University.......................New York, N. Y.
Ohio State University......................Columbus, Ohio
Pennsylvania State College...............State College, Pa.
Oregon Agricultural College.................Corvallis, Ore.
Polytechnic Institute of Brooklyn...........Brooklyn, N. Y.
Purdue University..........................Lafayette, Ind.
Rensselaer Polytechnic Institute................Troy, N. Y.
State University of Iowa........................Iowa, Ia.
State University of Kentucky...............Lexington, Ky.
Stevens Institute of Technology.............Hoboken, N. J.
Syracuse University........................Syracuse, N. Y.
Throop College of Technology...............Pasadena, Cal.
University of Arkansas...................Fayetteville, Ark.
University of California.....................Berkeley, Cal.
University of Cincinnati...................Cincinnati, Ohio
University of Colorado......................Boulder, Colo.
University of Illinois..........................Urbana, Ill.
University of Kansas.......................Lawrence, Kan.
University of Maine.............................Orono, Me.
University of Michigan...................Ann Arbor, Mich.
University of Minnesota................Minneapolis, Minn.
University of Missouri.......................Columbia, Mo.
University of Nebraska.......................Lincoln, Neb.
University of Oklahoma...................Stillwater, Okla.
University of Pittsburgh...................Pittsburgh, Pa.
University of Washington....................Seattle, Wash.
University of Wisconsin......................Madison, Wis.
Virginia Polytechnic Institute.............Blacksburg, Va.
Washington University.......................St. Louis, Mo.
Worcester Polytechnic Institute...........Worcester, Mass.
Yale University..........................New Haven, Conn.

Institutions in which the entrance requirements are equivalent to those established by the Carnegie Foundation are eligible for Student Branches. Bodies of students in the engineering departments of such colleges are invited to apply to the Secretary of the Society for information regarding the form of petition to the Council for a Student Branch.

The Student Branches are now commencing activities for the year, and accounts of their first meetings appear below.

## This Month's Reports

### BUCKNELL UNIVERSITY

*October 1.* The season opened with a well-attended business meeting, and was followed by a lecture on The Standing of the Engineer, by Professor F. E. Burpee, Mem.Am.Soc.M.E.

H. R. Pars,
*Branch Secretary.*

### UNIVERSITY OF NEBRASKA

*October 2.* Several honorary and regular members were elected at the first meeting of the Student Branch this season.

Dean Stout told briefly of the organization of The American Society of Mechanical Engineers and the importance of Student Branches. He was followed by Professor Seaton, who told of his experience when a student in connection with the Society. E. C. Hurd, a consulting engineer, of Lincoln, Nebraska, gave a short and interesting talk on The Practical Side of Engineering.

R. B. Saxon,
*Branch Secretary.*

### RENSSELAER POLYTECHNIC INSTITUTE

*September 30.* The first meeting of the Student Branch for the season took the form of a smoker and gave every indication that the Branch will be very active this year.

After the regular business an illustrated lecture was read by Professor Fairfield on the Manufacture of the S. K. F. Ball Bearings. The slides were especially good, and the lecture that accompanied them proved most interesting to all present. Professors Greene, Fairfield, Anderson and DuPriest, who were present, took part in the discussion which followed, answering many questions.

R. A. Marriott,
*Branca Secretary.*

### WORCESTER POLYTECHNIC INSTITUTE

*October 5.* Alfred C. Carhart, Mem.Am.Soc.M.E., works manager of the Crosby Steam Gage & Valve Co., gave a most instructive and interesting talk at the first meeting on Opportunities to Young Engineers.

The speaker emphasized several points for the students' consideration along the lines of real efficiency, management of men, service to mankind and finding one's real place in the engineering world. Each point was sent home by a pleasing story, as well as serious comment on things as one finds them.

It is seldom that the students have listened to so keen a thinker along industrial-management lines who could, by his mingling of the serious and the humorous, better drive his points home to the mind and heart.

H. P. Fairfield,
*Branch Secretary.*

# EMPLOYMENT BULLETIN

***THE SECRETARY** considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping anyone desiring engineering services. The Society acts only as a clearing house in these matters.*

*IN forwarding applications, stamps should be enclosed for transmittal to advertisers; applications of non-members should be accompanied by a letter of reference or introduction from a member, such reference letter to be filed with the Society.*

### GOVERNMENT POSITIONS

*The Society has been asked to make suggestions of men for the following positions with the Government. Non-members of the Society having the qualifications may avail themselves of these notices by enclosing with their reply a personal introduction to the Secretary.*

FIFTY ENGINEERS, with building construction or superintendent's experience for immediate work in France, in construction department of the Signal Corps, U.S.A., to receive the rank of First Lieutenant. Age limit 21 to 40, but men from 25 to 35 years of age are preferred. Technical-school men with military experience desired. Usual army physical examination required. 2254.

PAPER MAKER, familiar with the operation of paper machines, preferably man of experience; not prejudiced against man past middle life. Salary depends upon man. Location New York. 2262.

SIXTEEN ENGINEERS, to have charge under commanding officer of the engineering service in troop cantonment and to receive commissions as Majors in Quartermaster General's Department. Would be called upon to operate and maintain all electrical and mechanical equipment, including heat, light, power, plumbing, roads, sewage disposal and water service. 2272.

ORGANIZING ENGINEER in oil-well machinery, etc., to handle routing of work through the shops. Location Oklahoma. 2280.

SHOP SUPERINTENDENTS, ASSISTANTS AND FOREMEN for arsenal assignments. Location Massachusetts. 2290.

ORDNANCE INSPECTORS, 15 to 20 men, technically trained, with ability and good judgment. 2291.

ENGINEERS who may be classified as secretarial engineers or business managers. Experienced office men who combine engineering education with intensive office experience. Immediate problems have to deal with an increase of office force and erection and equipment of building for office purposes. 2323.

MECHANICAL DRAFTSMAN. Salary about $150. Location New York office. 2325.

HIGH-GRADE MECHANICAL ENGINEER with technical education and motor-transportation experience in Quartermaster Mechanical Repair Shop, for technical supervision of wagon, harness, clothing, shoe and tentage repair shops. Suitable men will be commissioned Captains. 2329 A.

GENERAL PRODUCTION SUPERINTENDENT of equally high grade for same shops. 2329 B.

FOREMAN, FIRST AND SECOND LIEUTENANTS. 2329 C.

SUPERINTENDENTS for new artillery-munition plant operating for Government. Experienced men to be commissioned for duration of War. Retained in civilian capacity after the War. (A) in general charge of plant, (B) in charge of high explosives, (C) in charge of shrapnel, (D) in charge of manufacture of fuses and primers, (E) in charge of wood-working plant for boxes to ship and pack ammunition. 2336.

ENGINEER of pronounced ability in mechanical lines for Government work. He must be able to build machinery of accuracy and precision, not only superintend the construction of the tools and jigs, etc., but organize an excellent inspection department. Prefer man from St. Louis vicinity. 2343.

MECHANICAL ENGINEER of proven ability, with considerable experience with electric auxiliary machinery and hydraulic-electric machinery. Man of very highest standing is desired. Salary not considered commensurate by the Government to qualifications desired. It is hoped rather that man of the highest standing in his profession will volunteer his services for this at nominal salary in spirit of patriotic contribution to success of the War. To act in a more or less consulting capacity in mechanical matters affecting ship design. 2359.

SUPERINTENDENT, with drafting experience on structural steel. College graduate preferred. Age 35. To serve in civilian capacity. Salary $2000. Location near New York. 2361.

DRAFTSMAN on building construction and structural steel, to serve in civilian capacity. Salary $1600. Location near New York. 2362.

PLANT ENGINEER on per-diem or annual basis of pay, familiar with layout of factories, especially along lines as similar as possible to armor-plant work. 2363.

### CIVILIAN POSITIONS

TOOL DESIGNER who is resourceful and can follow work through to completion. Technical man with practical shop experience. Location Connecticut. 185.

SALES ENGINEERS, between 25 and 30, good appearance, graduates of approved engineering college, preferably M.E.; would be expected to undergo period of probation and training in various offices of company before being given more responsible work. Apply by letter in own handwriting. State age, education, previous business training, if any, salary desired, etc. Location New York. 205.

DRAFTSMEN AND DESIGNERS experienced on valves and fittings. Good future with large concern. State experience in full, salary expected and references. Confidential. Location New England. 1002.

DRAFTSMAN AND ESTIMATORS for work of varied character with large concern. Offers good opportunity for advancement. Location New Jersey. 1104

GRADUATE MECHANICAL ENGINEER with theoretical knowledge of centrifugal machinery, preferably fans, pumps and compressors, also thoroughly familiar with design and methods of testing. Apply by letter. Location New York. 1140.

MECHANICAL DRAFTSMAN on automatic machinery. Salary $20 to $25. Location New Jersey. 1168.

TECHNICAL GRADUATE for drafting and engineering department for structural work and machine design. Conveying-machinery experience will be of advantage. Splendid future to right man. State fully education, experience, age, salary expected, etc. Record and applications confidential. Location Missouri. 1185.

SALESMAN, preferably experienced on conveying machinery. Splendid opening with good future for right man. Give full details of experience, age, salary expected, etc. Record and applications confidential. Location Missouri. 1186.

FACTORY EXECUTIVE, technical graduate, 30 to 35, for large textile-machinery manufacturing plant. Knowledge of up-to-date shop methods essential, also successful experience in handling of mechanics. Applicant would be required to spend from one to two years in shop to become familiar with various classes of work, after which position of assistant superintendent with further excellent opportunities for promotion will be open to him. Salary to start about $2500. Location Massachusetts. 1191.

DESIGNER, experienced on jigs and fixtures for miscellaneous machine-shop production work, including turbines, reduction gears,

guns and gun carriages. Attractive offer to man who would be capable of handling this class of work. Location Maryland. 2006.

DRAFTSMAN for general design of new machinery and improvement of existing machinery in large going plant. Position leads to industrial-management work. Give full particulars. Location Maine. 2020.

DESIGNERS, thoroughly experienced in turbines. Salary $200 to $300. Location New York. 2021.

DRAFTSMAN for concern manufacturing wire-rope tramways who would develop along lines of overseeing, erecting, etc. Salary $25 to $30. Location New York. 2032.

DRAFTSMAN familiar with water-wheel equipment. Technical graduate preferred. Unusual future in central Massachusetts concern. 2042.

YOUNG MECHANICAL ENGINEER, industrious and capable, familiar with fuel-economy tests, power plant, and with practical experience in construction and testing of modern Westinghouse steam turbines. Possibilities for advancement to right man. Location New Jersey. 2055.

DRAFTSMAN on a-c. or d-c. motor design. Salary about $40. Location New Jersey. 2058.

DRAFTSMEN on mechanical-stoker work, men familiar with boiler room layouts, building and construction or heavy machine design acceptable. Salary up to $30 to start, depending upon ability and experience. Permanent position. Location Pennsylvania. 2069 A.

DESIGNING DRAFTSMEN experienced in auxiliary marine machinery, hoisting engines, and hoisting-engine design in connection with this class of machines. Salary up to $30. Location Pennsylvania. 2069 B.

TECHNICAL GRADUATE as instructor in mechanical engineering, tracing, machine design, gas engines and machine shops, for southern university. Give age, education, experience, references and salary desired. 2098.

ESTIMATOR for New York concern engaged as engineers and contractors for power plant, ventilation, steam and hot-water heating. 2103.

TECHNICAL GRADUATES. Large growing paper-manufacturing corporation offers excellent opportunity for interesting and effective work to two young technical graduates with tact, initiative, ability and common sense. Non-graduates with two or more years' manufacturing experience considered. Desire men who can develop, and have vision to see and grasp opportunity. Fair living salary offered to start, with future dependent on self. Give complete information. Location Canada. 2105.

EXPERT TOOL- AND FIXTURE-DESIGNING DRAFTSMAN for line of safety valves, steam gages and similar equipment. Must have sufficient education and experience to take charge of drafting department within reasonable time. Location New York. 2115.

EMPLOYMENT MANAGER for plant employing 600 men in Pittsburgh district. Exceptional opportunity for experienced man. 2122.

COMPETENT YOUNG ENGINEER, with good education and previous experience with large concern dealing with marine and power specialties. Location New York. 2158.

PHYSICISTS, CHEMISTS, ENGINEERS, DESIGNERS AND DRAFTSMEN, for work of research, development, and design related to problems of telephonic, telegraphic and radio communication, which are matters of public importance. Opportunities for such men in both temporary and permanent positions. Apply by letter. Location New York. 2178.

PRODUCTION MANAGER, 25 to 33, technical graduate with practical experience. Clean cut, aggressive and of generous build. Work involves handling 500 men to 600 men assembling 1000 to 2000 radiators daily of 12 to 20 different kinds and keeping production moving. Design of tools and jigs taken care of separately, and position involves straight production of assembled parts. Salary approximately $3000. Location New York State. 2233.

MASTER MECHANIC, technically educated, experienced in maintenance of electrically driven mine machinery, air compressors, centrifugal pumps, etc. Two-year contract. State salary and experience. Location Peru, elevation 15,000 ft. 2238.

DESIGNERS for stationary engines of 1000 hp. and larger. Must have theoretical as well as long designing experience. Salary no object; will pay up to $5000 for right man. Immediate employment. Location Massachusetts. 2240.

CHIEF ENGINEER, in charge of designing railroad equipment and supplies, including motor cars, hand, push and velocipede cars, and locomotive standpipes. Technical graduate preferred. Line is competitive, requiring man with business point of view. Salary secondary consideration if right man can be secured. Location Middle West. 2247.

LABORATORY ASSISTANT, capable of making simple chemical tests of lubricants, etc., and investigations into qualities of steel, etc. Location Connecticut. 2256.

MECHANICAL DRAFTSMAN, capable of checking calculations. Location Connecticut. 2257.

YOUNG MECHANICAL ENGINEER to have charge of returned-material department. Work to consist of inspecting all returned material and writing up reports on its final disposition. Location Connecticut. 2258.

SAFETY INSPECTORS capable of inspecting manufacturing plants, contracting risks, apartment houses, hotels, stores, etc., and elevators. Prefer to employ men who have had previous experience in this kind of work with other insurance companies, state rating boards, or those who have held positions as safety inspectors in large plants; but any bright man who has had a mechanical training and is willing to work is in line for a position of this kind. 2259.

DRAFTSMEN for rolling-mill work. Technical graduates preferred. Steady employment and chances for advancement. Location Pennsylvania. 2265.

METER-PRODUCTION MAN, preferably mechanical engineer who understands the making of small meters, etc. Considerable experience in this line and ability to get production essentials. Location Long Island. 2267.

FOREMAN in machine shop, capable of handling standard machines, lathes, boring mills, drills, etc., for conveying machinery equipment. Salary $35 to $40. Location New York State. 2275.

SHOP SUPERINTENDENT for factory employing 5000 men engaged in producing medium-caliber projectiles for Government. Previous ammunition experience desired but not essential. Salary dependent upon ability. Location Pennsylvania. 2276.

DESIGNER of elevators, conveyors and mechanical equipment for industrial buildings. Location Massachusetts. 2283.

MAN OR WOMAN, preferably with technical education, for engineering computation department and the answering of engineering correspondence. Location Massachusetts. 2284.

YOUNG ENGINEER, experienced in general plant-construction work. Good opportunities for advancement. Prefer man exempt from military duty. Location Illinois. 2286.

ASSISTANT PROFESSOR of machine design and superintendent of shops, to teach machine design, mechanical and electrical, give lectures on shop organization and manufacturing processes and superintend work in forge, foundry, wood-working and machinery departments. Salary $1400 for college year. Location New England. 2287.

MASTER MECHANIC for large southern cotton mill controlled by established western corporation with many branches. Policy is to build up such a man from an M.E. or E.E. technical graduate with two or three years' general experience. Married man preferred. Salary to start $1800. Liberal opportunities for promotion. 2293.

YOUNG ELECTRICAL ENGINEER as assistant to chief in research department. Require man with experience, logical thinker, and resourceful habits. Salary $20 to $25 per week. Location New Jersey. 2294.

COAL- AND WATER-GAS MANUFACTURING SUPERINTENDENT. Large and progressive organization in the East considering extensions and reorganization, desires to get into communication with one or two vigorous, experienced executives, having technical knowledge of coal gas and water gas, and ability to keep on top of difficult labor conditions. 2295.

ASSISTANT SUPERINTENDENT OR MASTER MECHANIC. Fine opening for ambitious, progressive man. Salary according to ability. 2296.

DESIGNING SUPERINTENDENT for general supervision and maintenance work in chemical plant. Young man to grow with organization. Salary to begin $1800. Location New York. 2299.

MECHANICAL DRAFTSMAN experienced in working up design of detail parts, and some experience upon general design. Good opportunity with recently incorporated firm in Philadelphia. State experience, references, age and salary expected. 2300.

SUPERINTENDENT for machine shop manufacturing high-grade printing machinery. Must be good executive and thoroughly versed in modern methods of interchangeable manufacture. Give age, nationality and complete experience. Salary depends upon individual. Location New York State. 2301.

ASSISTANT in department of mechanical engineering of large university in Middle West. 1917 M.E. graduate. To help in grading class exercises. Salary $850 to $900. 2308.

MAN to superintend work of laboratory in school of military aeronautics; also man to operate aeronautical engines under their own power. Salary of former $175 to $200 and of latter $150 to $175. Location large university in Middle West. 2309.

DESIGNING DRAFTSMAN for chemical apparatus of all kinds. Location New York. 2311.

ORIGINAL DESIGNING DRAFTSMAN, capable of taking initiative in the design of high tension electrical-power transmission and substation work (32,000 v.). Confine statement of experience to this particular line and be specific. State age, nationality, married or single. $190. Location Canada. 2312 A.

ORIGINAL DESIGNING DRAFTSMAN, capable of taking initiative in design of metallurgical-mill construction and equipment. Confine statement of experience to this particular line and be specific. State age, nationality, married or single. Salary $190. Location Canada. 2312 B.

TECHNICAL GRADUATES. Opportunity for several young technically trained men, preferably with some practical experience in mechanical or electrical engineering. Give age, training and experience. Salary $90 to start. Location New York. 2317.

MECHANICAL DRAFTSMAN, exempt or over draft age, preferably about 35 to 37, good on general design of industrial-plant machinery such as necessary in manufacture of ingredients and dyestuffs. Salary $150 to $175. Location New Jersey. 2319.

ENGINEER in charge of maintenance and repairs, capable of handling 200 or 300 men of varying mechanical trades, and take charge of drafting room. To work directly under vice-president and chief mechanical engineer. Location New Jersey. 2320.

YOUNG MAN with practical experience in shop production; also some knowledge of designing, drawing, etc. Salary $2000 to start, increase according to ability. Location New York State. 2322.

MECHANICAL AND ELECTRICAL DRAFTSMAN, with some experience in power-house design. Salary $100. Location Arkansas. 2324.

CONSULTING ENGINEER to certify to plant and capacity of small snap manufacturing plant in Massachusetts. Italian origin preferred. 2326.

YOUNG MECHANICAL OR ELECTRICAL ENGINEER for office of power plant. Technical graduate preferred. Salary $100. Location New York. 2327.

INSTRUMENT MAKERS. Must be American citizens. Desire men capable of doing bench work connected with the assembly of exact mechanical and electrical devices, skilled in the final fitting for assembling, and capable of reading micrometers and blueprints. 2334.

HIGH-GRADE DESIGNER experienced in distilling apparatus, die-products, etc. Location New York. 2337.

ASSISTANT PROFESSOR of experimental engineering wanted by Pacific Coast engineering school. Must have had good technical training in laboratory work, especially along steam, gas-engine and hydraulic lines, also practical experience preferably in operation and installing of power machinery. Previous teaching experience desirable but not required. Salary about $1600, depending on qualifications. Man 26 to 30 preferred. Send complete data, experience record, personal details, recent photo, recommendations, etc., in first letter, as position must be filled as soon as possible. 2338.

TECHNICAL GRADUATE, with three or four years' practical experience in efficient operation of boilers and stokers, wanted for position of traveling engineer. Exceptional opportunity for man with initiative and ability to become expert combustion and steam engineer. Work requires extensive traveling in connection with investigation of power plants throughout the country. 2340.

DRAFTSMEN on jigs and fixtures in connection with Government work. Salary $30 to $40. Location Connecticut. 2341.

EXPERIENCED DRAFTSMAN, for power plant and boiler work. Salary $125. Location New York. 2342.

ENGINEER AND DRAFTSMAN. High-grade man as head man, or inexperienced man as second man. Location Oklahoma. 2344.

RECENT GRADUATES in mechanical engineering from schools of recognized standing desired for testing work in large steam-operated electric-power plants. Applicants with experience in testing work and now located in and around New York City will be given preference. State education, experience and salary desired. 2345.

ENGINEER familiar with abrasive processes as engineering sales manager with concern manufacturing metal finishing tools and equipment. Location New York State. 2346.

GENERAL SHOP SUPERVISOR, not less than 35, who would be shop representative or director of works. Must be American citizen, who has had considerable machine-shop experience on parts relating to electrical-instrument manufacture. Should be broad-minded, have executive ability, and be capable of intelligently handling minor details connected with shop supervision. Salary about $200. Location New York. 2350.

EMPLOYMENT SUPERVISOR, not less than 35. Must have broad shop practice and training to ask leading and pertinent questions regarding experience applicants have had. Should be good judge of human nature and capable of handling miscellaneous complaints and misunderstandings in shop. Should be systematic; would be required to supervise employees' records and application files, and attend to references given employees on leaving. American. Location New York. 2351.

FOREIGN REPRESENTATIVES for iron, steel and metals, export engineering and contracting, to be given five or six months' training in home office and then employed on staffs of the various local firms representing company in foreign countries. Representative Americans wanted; character, honesty, reliability, loyalty essential. Prefer single men over 30. Must have training as mechanical engineers, technical knowledge of steel; be practical salesmen, with commercial sense and considerable commercial experience. Salary $150 during training period, and as soon as definitely accepted as foreign representative small commission on any and all business done in territory to which assigned. 2352.

PURCHASING ENGINEERS for machinery in the engineering department of export firm. Immediate employment. Training in machine-shop practice, internal-combustion engines, steam-power plants, and some knowledge of electricity as well as of export business desirable but not essential. Salary to start $1800. Location New York. 2353.

ASSISTANT TO FACTORY MANAGER in small rubber-goods factory. Young mechanical engineer, two or three years' experience, who can undertake the design and operation of machinery and relieve factory manager of routine work. Experience in rubber business not essential. Location New York. 2360.

ESTIMATOR, young college graduate, for work in manufacturing and jobbing business. Location New Jersey. 2364.

SALES ENGINEER. Man of mature judgment, sales ability and some mechanical training, capable of meeting high class of prospects, to act as sales representative for a leading automobile-parts manufacturer, with headquarters in Detroit, Michigan. State age, experience and salary expected. 2365.

TWO MECHANICAL ENGINEERS familiar with building construction, power-plant design, installation of machinery. Location New Jersey. 2366.

EVAPORATOR EXPERT. Engineer experienced on design and sale of evaporating apparatus for large concern desirous of extending evaporating business. Letter should contain detailed information as to past experience, qualifications and salary expected. Location New York State. 2367.

CHIEF DRAFTSMAN with executive ability; capable designer, competent to supervise ordering of materials and with capacity for details. Experience in general machine design, structural steel and electrical machinery. Salary $300. Location New York. 2372.

GENERAL MANAGER for concern in the Middle West employing 250-300 operatives. Product is light hardware in pressed sheet brass, etc. Press and automatic screw machine work, small intricate machines with dies and tools. Should be experienced in locating and buying materials, cost accounting, selling and factory management in metal lines. Prefer man who has a desire to become a member of the firm and ability to interest capital in expanding the business. 2381.

## MEN AVAILABLE

CONSTRUCTION SUPERINTENDENT. Japanese, age 42. Fourteen years' practical experience in mechanical and electrical installation work as foreman, inspector of railroad cars and electrical building constructor. At present employed in one of the largest traction companies as power-plant and sub-station designer. K-368.

STEAM AND COMBUSTION ENGINEER. Technical graduate, age 34, married. Nine years' practical experience with large concerns, including executive experience and the handling of men. Desires change of location. K-369.

MECHANICAL DRAFTSMAN, age 25, experienced in the design, erection and operation of power plants, wishes a permanent position with a power company or consulting engineer. Not less than $125 per month to start. Position in New York City or on Long Island preferred. At present employed. K-370.

CHIEF DRAFTSMAN OR ASSISTANT ENGINEER. Associate-member, age 26, American-born and single, desires change of location. Now chief draftsman of a staff of twelve, totaling a monthly payroll of over $2000. Specialty, large industrial plants, as mining and smelting, covering all branches of engineering. Salary $250 a month. K-371.

SUPERINTENDENT OR MASTER MECHANIC. Associate-member, age 40. Thoroughly experienced in modern factory methods, organizing, planning and supervising the manufacture of interchangeable products. A-1 designer of tools, dies, fixtures and labor-saving devices for rapid production. Has been employed for a number of years in executive capacities as toolroom foreman, master mechanic and superintendent. Lately connected with munitions manufacture as assistant general superintendent of factory employing 500 hands. Immediately available. K-372.

MECHANICAL ENGINEER. Member, age 37, married, with sixteen years' experience in design, manufacture and operation of Diesel and hot-bulb engines for stationary and marine work, will be open for engagement January next. At present prominently connected in this line. Prepared to take charge of and follow up work already started or to design and develop any size or type of marine or stationary oil engine. K-373.

MECHANICAL ENGINEER, age 40, with broad experience in design, estimating, sales, and executive work. Especially qualified for power-plant design and sales, including sugar factories. At present employed as manager of branch office of machinery-export company. Desires position of responsibility where commercial and technical sides of engineering are combined. Speaks Spanish. Position must be permanent and offer a future. K-374.

WAR-INDUSTRY MANAGER. Opportunity for active work on war necessities, such as ships, guns or ammunition desired by man of 38, experienced in Corliss-engine building, heavy machine work, and steam-power-plant design and construction. Has held machine-shop positions from apprentice to works manager. Organized and operated for a year a successful shell-manufacturing plant. Rejected for active military service on account of minor physical defect. Present position not directly useful in conduct of war. No position not directly necessary to United States at war will be considered. K-375.

CHIEF ENGINEER OR MASTER MECHANIC, with thorough technical and practical experience, covering construction, operation and upkeep of steel plant. Specialty, metallurgical work, heating and melting furnaces. K-376.

SAFETY ENGINEER, with six years' thorough technical and practical experience in this capacity with large steel works in Pennsylvania. K-377.

COMBUSTION ENGINEER. M.E. graduate, age 35, with considerable sales experience, would like to devote part time to the sale of high-grade boiler-room specialties on a commission basis, in and around Cincinnati. K-378.

ROLLING-MILL ENGINEER, technical graduate, age 36, desires responsible position. Has had fourteen years' experience in entire charge of the design of billet, rod and strip mills, merchant mills, etc.; also complete wire-mill plants. At present employed. K-379.

PRODUCTION MANAGER OR SUPERINTENDENT, member, age 35. Present connection, 17 years with large metal-working corporation; last five years as production manager. Experience covers detailed knowledge of metal trades and manufacturing. Versed in industrial engineering. Location immaterial. Salary to start, $4000. K-380.

FOUNDRY SUPERINTENDENT. Member, at present employed in high-grade plant, desires change. Practical molder, coremaker and melter of gray iron, semi-steel and non-ferrous metals. Technical graduate with broad experience in modern shop methods and various types of molding machines. Good organizer. Can furnish excellent references from present and past employers. Nearly seven years in present position. Must be open shop. K-381.

GRADUATE MECHANICAL ENGINEER, age 30, born in Russia, and speaking Russian. Five years' general machine-shop experience; two years' experience in the manufacture of small tools and instruments; one year in the automobile business. Wishes to connect with concern presently doing business with Russia, or contemplating same after the war. K-382.

EXECUTIVE MECHANICAL ENGINEER, WORKS ENGINEER, CONSTRUCTION SUPERINTENDENT OR DRAFTING-ROOM DIRECTOR. Associate-member, American, age 34, married. Eight years' general engineering experience, covering complete design, construction and maintenance of steam-electric power stations and other public-utility properties. Easily adaptable to conditions; energetic and ambitious. Has reached limit of advancement with present employers. Prefers to connect with an industrial concern in a position offering possibilities. Will be available upon two weeks' notice. K-383.

MECHANICAL ENGINEER OR PLANT ENGINEER. M.I.T. graduate, age 25, desires position in engineering department with opportunity for advancement and greater responsibility. Two and a half years with large textile-finishing concern, in charge of engineering department and drafting office. Experienced in general mill engineering, plant maintenance, machine design, power transmission, building construction, concrete, factory reorganization, installation, and equipment. Can design, supervise, organize or install new work. At present employed. K-384.

MECHANICAL ENGINEER, age 33, with eleven years' estimating, designing and shop experience on boilers, superheaters, stokers and oil burners; also with heating, ventilating and air conditioning, desires position as chief draftsman or assistant to chief engineer or manager of progressive concern, where conditions allow development of ability. Location, New York or Brooklyn preferred. K-385.

EXECUTIVE MECHANICAL ENGINEER. Member, age 41, American, married. Twenty years' practical experience as designer, chief engineer, general manager, and consulting engineer. Thoroughly convrsant with all details of shipbuilding, medium-size steel and wooden steamers; machine and foundry business, manufacture of special machinery and tools; steam engines, boilers, hoisting machinery, dredging and excavating machinery, marine auxiliaries, repairs, estimating, cost accounting, purchasing, management, etc. Desires change, preferably with new company on war contracts, ships, engines, or special machinery. Only permanent executive position considered. K-386.

ASSISTANT TO EXECUTIVE. Graduate mechanical engineer, trained in the electrical industry and accustomed to meeting and handling men, desires position where tact, diplomacy and a keen business sense are required. At present employed in position combining engineering with public relations and commercial activities. K-387.

GRADUATE ENGINEER with twelve years' manufacturing, executive, sales and business management experience. Would make good assistant to executive officer or business manager. K-388.

MANUFACTURING EXECUTIVE for interchangeable parts. Technical graduate, age 32, married. Nine years' experience—four and a half years in last position, as head of department laying out routing cards, ordering and specifying tools for new-parts manufacturing; and as chief inspector. K-389.

EXECUTIVE MANAGER. Mechanical engineer of marked ability, with proven successful record and complete experience necessary to conduct machine tool, precision machinery or similar business. Has directed organization of 12,000 men and served with three leading firms in their respective fields. Now employed but open to consideration for further opportunity. K-390.

# ENGINEERING SURVEY

## A Review of Engineering Progress and Attainment in Mechanical Engineering and Related Fields, Including a Digest of Current Technical Periodicals and a Selected List of Engineering Articles

### American Institute of Electrical Engineers

A MEETING held at Philadelphia on October 8, 1917, was devoted to the subject of industrial research.

Prof. A. P. Kennedy presented a paper on Industrial Research and the Colleges, in which he advocated that a proper relationship should exist in the industrial field between the pure science college, the technical college and the industries themselves, and made an attempt to indicate what this relationship should be.

The speaker defined industrial research as scientific investigation directed economically toward improvements in production.

In the non-technical scientific departments of the colleges and universities are included such fundamental subjects as mathematics, physics and chemistry. The teaching and the learning, the latter by carrying on researches in the above-named sciences, have to be carried on interdependently and perpetually. It is probably undesirable that the pure-science departments of colleges and universities should continuously undertake industrial research, because there is so much other important work to be done which calls exclusively to the province of these departments. In physics, chemistry, mathematics there is a limitless field of undreamed-of knowledge where the instructing staffs in the colleges have special facility for advancement. Barring exceptional conditions, such as those due to the present world war, as a general rule, the best contribution of these departments to industry is by restricting their attention to pure science.

The position of the engineering and technical schools is somewhat different. Their field of activity is intellectually narrower, but, on the other hand, they come into closer relations with the needs and problems of the industries. There are various ways in which technical colleges can assist in industrial research, the selection of which depends on conditions of each individual case.

Younger industries, lacking their own research facilities, naturally turn to the technical colleges for help. This is a call which the colleges would desire to meet so far as they can do so without disrupting their regular work of teaching and learning. The stumbling block in the way, however, is the need for secrecy, as the whole atmosphere of any healthy college is one of intellectual freedom, with all knowledge placed at the academic disposition of everybody around.

In the long run, it seems most desirable that the technical colleges should always carry on general researches in their laboratories of such a nature as may advance applied science, stimulate careful observation on the part of students, contribute to the published fund of available technical information and supply new knowledge to the teaching staffs and train students for entering industrial research. Simultaneously, a limited amount of industrial-research work may also be advantageously carried on in the college laboratories.

An ideal international system would be one in which the pure-science colleges should lay the foundations of future industries by enlarging and disseminating the world's knowledge of the basic scientific principles, the technical colleges should do the same for applied science, while at the same time taking a share in the economic applications of science to industry. The industries themselves should undertake their own researches under the guidance of qualified research specialists. Vocational schools would train industrial foremen in the elements of the same principles of science, art, technique, economy, thrift and hard work, as applied to those particular industries in which each nation is, by its peculiar circumstances, specially adapted to excel.

This paper was followed by an address by C. E. Skinner on industrial research and its relation to university and governmental research.

The author divided research activities into three principal classes: university, governmental and industrial.

Of greatest interest is what the author said as to university research. In his opinion, the principal function of university research should be to train research men. Men with the broadest and best training possible are going to be required in ever-increasing numbers for every possible phase of the work. The fundamental training of these men must be gotten in the university, and universities should be equipped to turn out research men just as they are now turning out men with academic and engineering degrees.

In this connection, it is rather a sad fact that the university has not been able to make its teaching positions more attractive by providing compensation more in line with that obtainable in other fields. While writing this paper the author received letters of inquiry for several men for teaching positions, with specifications which could be met only by men of considerable experience. The compensations named were very much less than those which men with the same qualifications could command in other lines.

The teaching profession is said to have many compensations, such as short hours and long vacations, but the average salary is certainly not one of these special attractions. We have splendid endowments for buildings, and sometimes for equipment, but practically no endowment for men of genius who might make notable progress in pure research and at the same time serve as teachers and examples for the training of men for the whole field. If it takes a genius to recognize a genius yet undeveloped and properly stimulate and direct him, how necessary it is that we place men of genius at the head of the research departments of our universities.

### Society of Automotive Engineers

AUTOMOTIVE engineering in the great war formed the subject of an address by Geo. G. Dunham before a recent meeting of this society. The term "automotive," according to the speaker, includes the motor-car, aeronautic, tractor, motor-cycle, marine- and stationary-engine fields; in fact, every type of self-propelled vehicle. In time of war these problems become of particular importance, and that is why

the automotive engineer must enter the Government service, as many have already done, or otherwise discharge patriotic duties by the closest coöperation with those in authority.

It is evident that this is not only a war of engineering competition, but that the internal-combustion engine is one of the most vital elements in every phase of its conduct, a condition which will explain the reason for the extraordinary activities of the S.A.E.

The automotive engineers have to take charge of the problems to be met in keeping the fleet of army trucks in operation, problems far more serious than those encountered in normal peace times. Wretched conditions of roads and excessive loads make the necessity of repairs and renewal of parts acute. It has been stated on good authority that frequently two-thirds of the trucks on the Western front are out of commission awaiting or undergoing repairs. While this would indicate the imperative necessity of standardization, the Allied governments have not yet adopted a single standard motor-truck design. The American government has already done so and in this was actively helped by the automotive engineers.

As a result, the Government has in process of production a truck which is not only rugged and finished as a design, but is capable of rapid production and above all simple and easy repair, the parts being made with the view to easy renewal and absolute interchangeability. There is also a smaller number of parts and, in many cases, the same parts have been used in both of the two sizes thus far designed.

These trucks were designed primarily by and for the Quartermaster's Department, but will probably be largely used by other departments requiring fairly heavy equipment. On the other hand, the Signal Corps will require relatively light high-speed trucks to act as aeroplane tenders. These trucks will be mounted on pneumatic tires and be capable of a speed of abount 50 miles per hour. In the Medical Corps a somewhat similar chassis is to be used for ambulances. In the Ordnance Department a quite different set of conditions must be faced. The increase in scarcity of horses, the necessity for greater speed and greater tractive effort have made it necessary for the Ordnance Department to undertake extensive motorization of its equipment. Accordingly, a group of automotive engineers, men, for the most part, with experience in the design of tractors, are now working on this problem. In addition to the tractors used by the Ordnance Department a large number of 4-wheel-drive trucks will be provided for the handling of ammunition and other similar purposes.

There is another branch of automotive engineering about which much less has been written, but in which work of great importance is being done—the development of small stationary or semi-portable units for the operation of wireless sets, searchlights, pumps, isolated electric lighting plants and machinery in portable repair shops.

Perhaps, a still more important work done by automotive engineers is concerned with the development and production of the farm tractor. This type of agricultural machinery is playing a tremendous part in the production of food, which, after all, may be the determining factor in winning the war.

The speaker also discussed in some detail the part played by automotive engineers in the development of standardization of motor cycles and aeroplane engines.

## American Foundrymen's Association

During the past few months several organizations have chosen Boston as the meeting place for their convention, and the latest of these, that of the American Foundrymen's Association, took place in that city during the week of September 24.

Each morning during that week was given over to business sessions and discussions of foundry subjects covering gray cast iron, malleable cast iron, and steel; while the afternoons were devoted to pleasure trips and sightseeing.

During the week the exhibit of foundry equipment, supplies, etc., attracted many foundrymen to Mechanics' Building, where spaces were taken up by about 160 different exhibitors. The exhibit opened on Monday, at 9.30 a. m., with a simple but patriotic program particularly fitting at this time, and this was repeated each succeeding day of the convention at the same hour in the morning and at 2.30 in the afternoon. It consisted of the formal raising of the American, British and French flags, on the stage in Grand Hall, at the call of the bugle.

This exhibit being a little different from most of those seen at Mechanics' Building, in that the materials exhibited were not particularly interesting to the general public, was, nevertheless, an extremely interesting and instructive one to the foundryman, and it was estimated that thousands of dollars in contracts were placed during that week.

In the different exhibits, the condition of the times seemed to be taken into account, in that the efforts of the exhibitors were along the lines of maximum speed and quantity with less labor and materials.

The labor question being as it is at the present time, it is very evident that every effort should be made toward getting out work with as few men as possible, at the same time keeping the quality and output at the highest point.

This was seen in the various types of molding machines exhibited where hand ramming was done away with and all the movements controlled by the turning of valves.

The show taken as a whole was a very attractive one, and several exhibits were especially artistic. One in particular received a considerable amount of attention: that of the New England Coal and Coke Company. It consisted of a reproduction of Bunker Hill monument built up of coke by that concern. The monument itself reached nearly to the ceiling of Grand Hall and was surrounded at the base by four large statues of typical Puritans.

The exhibit was indeed an attractive one, and drew the attention of over two thousand visitors from different parts of the country.

F. H. Cole.

## National Welding Council

On Tuesday, September 25, at a meeting held at the Engineering Societies Building, New York City, representatives of the various societies and manufacturers interested in welding organized what is to be known as the National Welding Council. This council is intended to be somewhat of a permanent organization, at least until this work shall have been completed. Its object is to thoroughly investigate autogenous welding both as to theory and practice, particularly as applied to pressure vessels, utilizing the knowledge and data at present available, and going into further research work if it is found necessary, and all of this with a view of ultimately formulating a code which shall be used to regulate the practice of welding after the manner of the present Boiler Code.

Meetings are to be held monthly, the third Wednesday being the day now set, and the outlook now seems to be very good for definite results.

F. L. Fairbanks.

# U. S. BUREAU OF STANDARDS

THE following abstracts, with the exception of the last one, have been composed from material courteously supplied to THE JOURNAL, in response to its request, by the Director of the Bureau of Standards.

The last abstract, describing a feature of the activities of the Bureau most intimately connected with the present war, was taken from *The Automobile and Automotive Industries*.

Particular attention is here called to the intensely practical nature of the subjects investigated by the Bureau of Standards. To cite but one instance: properties of glue. Hitherto there were but few concerns which used glue on a large scale in high-grade products, and which had more or less adequate means of testing this capricious material. Not even all glue factories could tell, and prove, what kind of product they were making.

The growing application of glue, especially for aeroplane propellers, necessitates a clearer understanding of the behavior and properties of this material, and the investigation by the Bureau of Standards is therefore a timely one. That it will cover the subject in a scientific as well as exhaustive manner will not be questioned by any one who is at all familiar with the usual type of work by our national laboratory.

### Sole-Leather Testing Machine

The Bureau of Standards is using its new type of leather-testing machine in investigating the durability of the shoes of postmen in the District of Columbia. About 20 different brands of sole leather are represented. The relative behavior of these leathers in service will be compared with the results of the laboratory tests, as a basis for developing a standard method of testing sole leather.

### The Properties of Glue

The Bureau is conducting an investigation to correlate the physical and chemical properties of glues, with a view to the formulation of rational standards of quality.

### Optical-Glass Production

The Bureau of Standards has produced on a manufacturing scale all kinds of optical glass required for military purposes. The Bureau is now coöperating with the manufacturers of glass in the actual production of optical glass in the quantities and kinds required. One critical problem solved was the production of suitable pots in which to melt the glass. The Bureau was obliged to make pots for this purpose which would not discolor the glass and which would not be eaten through during the melt. As yet the pots commercially available are unsuited to the purpose.

### Graphite Crucibles

The production of graphite crucibles has been perfected. Eighteen mixtures were made which showed satisfactory service tests.

### Researches on Metals

Progress is being made in the metallographic and chemical survey of ingots and blooms, much of the work being done on night shifts. The investigation of the effect of casting and molding methods upon the strength of test bars for copper is being continued. Many castings have been made for investigational purposes. Experimental heat treatment of the steel rings used for ball-bearing races was made as a basis for the magnetic tests for mechanical properties.

### Testing of Columns Under Fire and Load Conditions

In the comprehensive program for testing the fire-resistive properties of materials, the Bureau has just tested three columns of gravel concrete under conditions of load and fire and three of limestone-concrete columns under load without fire. The gravel concrete columns showed failure in the outer shell early in the test. This is attributed to the expansion of the outer shell or layer of concrete. The limestone columns thus far tested show no such tendency, the heat penetrations being correspondingly less.

### Electrical Conductivity of Porcelain

About one hundred determinations of electrical conductivity of porcelain have been made up to temperatures of 1000 deg.

### Military Research

The Bureau is engaged on researches and investigations having direct military application, and involving physics, chemistry, and engineering. These researches are, for the most part, confidential. A very interesting line of work of this kind has to do with the system of standardizing gages for munitions plants and arsenals.

### Apparatus for Studying Stresses in Fabrics

Special apparatus has been prepared in the Bureau of Standards for studying the distribution of stresses in fabrics when subjected to a uniformly distributed pressure. The purpose is to aid in the economical design of certain structural fabrics and to obtain a clearer understanding of the control of the variables in textile manufacturing. The testing apparatus for textile research is placed in a room in which the humidity is maintained at a standard constant value by means of humidifying apparatus and control designed and constructed at the Bureau.

### Liberty Motor Testing Plant

Description of the aeroplane-motor-testing plant at the Bureau of Standards grounds, in which is a vacuum chamber for the testing of aeroplane engines at atmospheric conditions ranging from that found at sea level to that found at an altitude of 20,000 or more feet. In this chamber the engine can be started at sea level and "fly" as high as need be for observation purposes, and it can "land" as quickly or as slowly as desired.

The chamber is 6 by 6½ by 15 ft., with walls 12 in. thick, made of concrete and reinforced with steel, and not only is the reduction of pressure arranged for, but provision made to care for the exhaust of the engine. Provision also has been made for the heat produced by the engine which, in the open

upper sky, would be dissipated. There is a mounting similar to that for an aeroplane, and the air left in the chamber is kept in rapid motion when tests are on.

One end of the chamber has big refrigerating coils, filled with ammonia, and five big fans provide the circulation. Openings in the side were made necessary for passage through them of water, ammonia, thermometers, pressure gages, and other devices. A shaft runs through a stuffing box to the outside to connect with an electric dynamometer, to observe the power up to 450 hp. The compartment is lined with cork, and the air that supplies the chamber must be brought in at a temperature to correspond with 0 deg. fahr., which aviators find 20,000 ft. above the ground.

Surrounding the chamber is a stucco structure, 24 by 50 ft., containing the ammonia refrigerating plant, an exhaust blower with a capacity of 1500 cu. ft. per min., weighing devices, measuring arrangements for estimating water and heat, including the heat which escapes in the water, the heat which escapes in exhaust gages, and also the heat that leaves the engine in the circulating air around it; also, for gaging the temperatures of air and water, for indicating the pressure of the air in the vacuum chamber, the volume of air used to supply the engine, the power and speed generated, and various other factors.

Doors leading into the chamber weigh 500 lb. each, and they are made so the covering will fall off in case of an explosion, that the chamber may not be wrecked. For observing the test, port holes, covered with glass an inch thick, are provided. (*The Automobile and Automotive Industries*, vol. 37, no. 14, October 4, 1917, *d*)

## Eye Accidents in the Industries

The outbreak of the European war brought such a shock to labor conditions that a period of unemployment followed. By the end of the first year, however, the equilibrium was again established, and with the decrease of workers in Europe came the demand for greater manufacturing in the United States than ever before. As a result of the necessity for increased output, the demand for labor became so great that workers unacquainted with industrial hazards entered munition and other factories. That the Committee might know exactly how these new difficulties were being met, the national organization undertook an intensive study of factory conditions in Buffalo, New York. The work of investigation is now completed, and it is expected that a full report will appear in 1917. (Eighth Annual Report of the New York State Committee for the Prevention of Blindness, Nov. 1, 1915 to Nov. 1, 1916)

## How to Aid Workers Hurt in War

Every country that has sent men to the front must face the possibility of having some returned crippled and disabled. What to do with these men and how to do it will be the gigantic problems that must be faced, and our ability to solve them successfully will depend to a great extent upon the amount of previous planning and preparation. It is not a pleasant subject for thought; one would readily shut his eyes to it until we find ourselves with our quota of crippled workers, for whom there seem little means of providing a livelihood.

Almost a thousand members of the National Association of Manufacturers, representing great industries in every section of the country, have sent written expressions of their desire to participate in a practical way in the economic rehabilitation of men injured in the war.

That disabled soldiers and sailors have an inalienable right to maintain their positions in their communities with self-respect and independence is unquestioned, and any suggestion that the situation be handled through charitable organizations shows a shocking disregard of the rights and feelings of those who have made supreme sacrifices for their country; to force them to become public charges is obviously as unfair to them as it is to the community.

The consensus of opinion among manufacturers so far questioned seems to be that the fairest way of helping wounded men is by helping them to help themselves, and they unanimously pledge their coöperation.

So far as the employment of disabled men is concerned, a safe generalization is that occupations needing strength and endurance rather than skill are for the most part closed to such workers. The various lines of the iron and steel industry come under this category, and as a Pennsylvania iron and steel company writes: "Our operations would afford a poor place for the employment of men crippled in the present war, as the work is dangerous, and unless a man is able to take care of himself, he is at a serious disadvantage." (*Journal of Commerce*, September 18, 1917, p. 5)

## River Barges Moved by Artificial Wave

With the Ohio River at summer stage, thousands of tons of coal were brought to Cincinnati harbor from the upper river districts recently on the crest of an artificial "flood wave." The experiment was made under the direction of Colonel Beach of the United States engineers of that district.

By allowing the pool waters in tributary streams to be released, through lowering the dams, Colonel Beach created an unnatural "wave," which, entering the Ohio, gave a stage high enough to float down the loaded barges. The opening of the dams was carefully timed, and as each new supply of water swept into the parent river, the stage was maintained and the barges reached Cincinnati safely.

So successful was the trial that a conference of coal shippers was called at once at Marietta, Ohio, and arrangements were made to use the "artificial flood" at regular intervals during the low river stages. Colonel Beach explains that this new method will release thousands of coal cars and help to no small degree in lessening the demands on the railroads. (*Christian Science Monitor*, September 11, 1917, p. 5)

## Possible Use for Waste Timber

By using timber heretofore used only for firewood and considered worthless for any other purpose, a new industry is being started in Mississippi, and its rapid growth gives promise of its attaining considerable magnitude and influence in the state.

Refuse wood is being cut into blocks 2½ ft. long and from six inches to more than two feet in width and thickness. White oak and hickory blocks are then shipped to factories for making wagon and buggy spokes, while red-oak and water-oak blocks go to furniture factories to make small articles of furniture.

Several cars already shipped North have found ready markets, and this, with the fact that the waste, wood supply is unlimited in this section of the state, has made investors believe that the industry will be a permanent one. (*Christian Science Monitor*, September 11, 1917, p. 7)

## Research Progress in Britain

The report of the Advisory Council of the Privy Council Committee on Scientific and Industrial Research for 1916-17 has recently been published. The report is prefaced by a report of the Privy Council Committee, in which is a recommendation that the sum of £1,000,000, handed over by the government to the imperial trust for the encouragement of scientific and industrial research, should be spent in the form of grants in aid to firms in an industry undertaking research, and who may combine to conduct such research on a coöperative basis.

The report of the Advisory Council is divided into two parts. Part I describes the steps taken to deal with the problem of industrial research where practicable on the coöperative basis, and by the department itself where independent state action is required. Substantial progress, the report states, has been made towards establishing a national research association in connection with the great staple industry in cotton, and a scheme of procedure has been worked out in considerable detail. Woolen and worsted manufacturers in Great Britain are following suit, and a provisional committee has been appointed to draft the constitution for a research association. Irish flax spinners and weavers, it is stated, have also decided to take the same step.

"There are also a number of industries," the report continues, "which are so circumstanced that their firms are unable to combine in this way. In some cases the leading firms fully realize the value of science and of combined attack, but they cannot as yet carry the industry with them. For example, the papermakers are urging the council to establish a state laboratory, to the initial and maintenance cost of which they are anxious to contribute.

"The Council note that there are important fields which research associations cannot expect to cover, one of these being research into fuel. Here they consider it simpler and more just that all should contribute through the taxes to the cost of the research. A fuel-research board has, therefore, been formed by the Council. This board has presented its first report, in which are outlined its proposals for taking stock of the coal resources of each district and for classifying, according to their qualities, the seams which are being worked or which might, in certain circumstances, be worked, and ascertaining broadly the industrial uses to which the different kinds of coal are being put." (*Christian Science Monitor*, October 5, 1917, p. 3)

## Six-Hour Day for British Labor

That the study of labor conditions, as developed by the war, had demonstrated the advisability of a six-hour working day was the statement of Lord Leverhulme, president of the Welsh National Eisteddfod, made in an address at the annual meeting of that body. Lord Leverhulme is chairman of Lever Bros., Ltd., the soap manufacturers. In his address he also discussed the financial conditions growing out of the war. In part, he said:

"We have learned much the last three years on the subject of fatigue, overwork, and excessively long working hours. We have proved conclusively that prolonged hours of toil, with resulting excessive fatigue, produce after a certain point actually reduced results in quantity, quality, and value than can be produced in fewer hours when there is an entire absence of overstrain or fatigue. Fortunately, however, this logical effect of overlong hours of continuous work does not apply, except to a very limited extent, in the case of machinery and mechanical utilities.

"Therefore, we shall require an enormous increased output of goods to replenish stocks that have been allowed to run down both for our home and export trade, and as we have the machinery available, and which hitherto in most industries has only been run 48 hours per week, a solution of this one of our difficulties can be best and most readily found by working our machinery for more hours and our men and women for fewer hours. We must have a six-hour working day for men and women, and by means of six-hour shifts for men and women we must work our machinery 12, 18, or 24 hours per day.

"In considering the six-hour working day and its advantages for increased output with lessened overstrain and avoidance of overfatigue, we must not overlook the great assistance it will be in solving the problem of education. Our men and women working in factories and mines and allied occupations, including clerical work—in fact, any form of work that is from its very nature mechanical, arduous, or monotonous—have been employed during such hours each day that from mere lack of time and opportunity they can never receive proper education, and are consequently undereducated. If to these conditions of hours occupied in daily labor you also take into consideration, as unhappily must often be the case, to arrive at its true bearings on the problem of education, that our workers are often also underfed, underhoused and overcrowded in insanity kill-joy homes, how can we wonder at what is called 'labor unrest'?" (*Journal of Commerce*, October 2, 1917, p. 5)

## A German Appreciation of Enemy Aircraft

A number of French and British aeroplanes which have fallen into German hands have been exhibited at the Berlin Zoological Gardens. The exhibition contained 31 machines, most of them complete, but a few with the motors removed. Of these 15 were British, 15 French, and one Russian. There were also exhibited a number of engines, some more or less damaged. Three of the machines were hydroaeroplanes.

Nine of the machines were single-seaters and 22 double. Five were monoplanes and 26 biplanes. Nine had stationary motors and 13 revolving ones, while two had two motors each. In seven machines the engine was behind the pilot, and in 22 in front, while in two it was at the side. Among the makers represented were the Franco-British Aviation Company (1 machine); Deperdussin (1); Nieuport (5); Morane-Saulnier (3); Farman Bros. (1); Caudron (2); Voisin (1); Blériot (1); Ferner Vickers (2); Martinsyde (1); Sopwith (1), and Avro (1), with six of the British Experimental Co. and four of the Fighting Experimental Co.

The general comment made on these machines in an article in the *Zeitschrift des Vereines deutscher Ingenieure* is that they are not nearly so well finished as the German machines, nor so comfortable for the pilot, and the arrangement of the levers and instruments is criticized as unpractical. It is admitted that the short life of the machines may be a justification for not spending too much time on their finish; on the other hand, it is argued that the permission for poor finish may be an inducement to pay insufficient attention to the vital parts of the machine. Surprise is expressed that the Allies are still building machines with the engine behind the pilot, although the utility of such machines is admitted as giving a free field for vision for navigation as well as for the use of the machine gun.

The machines are divided by the enemy critics as being built on two different principles. In one class it is said that lightness is aimed at with the sacrifice of non-resistance to the air, and it is remarked that if such machines are to be serviceable they must have a comparatively small pressure on the planes—that is, they must have a great plane area for a given weight. They are considered to have powerful engines in proportion to their weight, but as the engine power is practically only of importance in its relation to the load to be carried, the machines are none the less regarded as efficient. Into this category are put the machines of Voisin, Farman, Caudron, Fighting Experimental, and Vickers, all with motors behind or with two motors. In the other class the principal endeavor is said to have been to reduce the air resistance to the minimum possible; the machines are therefore heavier, but permit of a greater load per square foot of plane surface.

The Voisin machine, with its tangle of wire stays, is picked out as the extreme of the first type, and as a contrast the British Experimental is named as the best representative of the second type. In the latter machine the air resistance has been reduced to a minimum, the body of the machine being so narrow that openings have to be cut into the side to give the pilot elbow room. It is also mentioned that even the wire stays are of a lentil-shaped cross-section to reduce the resistance to the air. Other criticism and comparison are withheld, except for the remark that for German machines the second type has always been followed. Similar requirements are believed to be fulfilled by the first class, but the means by which they are arrived at are criticized as primitive.

In conclusion, it is pointed out that the exhibition must in no wise be considered as representing the present state of the art of building aircraft among the Allies, the latest machines not being exhibited. (*Times Engineering Supplement*, August 31, 1917.)

## Chemistry and Finance

At a meeting of the New York section of the American Chemical Society on September 28, 1917, the subject of Chemistry and Finance was taken up, with particular reference to the true relation of banking to chemistry. The subject is an interesting one and suggestive of the connection between engineering developments and finance. It is well known how in Germany the close coöperation between the engineer, in particular, the inventor, and the banker, has helped the progress of industry in that country.

The two addresses made at the meeting, one by Dr. A. D. Little, Mem.Am.Soc.M.E., of Boston, Mass., representing the chemist's side of the question, and the other, by Mr. G. A. O'Reilly of the Irving National Bank of New York, showing the banker's point of view, comprehensively presented the situation as it is in this country.

The basic idea in Dr. Little's address was that the time has come for chemists and bankers to find a common language and establish a mutual understanding. Some bankers are finding it worth while to study Spanish, because it leads them into a new financial world. It is in the power of chemistry to open up a new universe of finance.

The speaker pointed out, however, that the chemist has not learned the proper formula for presentation of his projects, especially large ones, to bankers. In the case of a chemical plant, especially where new processes are involved, a generous allowance must be made for unforeseen expenditures. Chemical investments in their various stages are undoubtedly speculative, and often highly so in character.

The banker's viewpoint was expressed by G. A. O'Reilly, who stated that the point of contact of the theories of banking and the practice of chemistry is a subject which, it is feared, has not claimed the attention of banking circles in the past to the extent to which its merits would appear to entitle it. However, these are not normal conditions in the least, and questions are handled in a way different from that of pre-war days.

The true relation of banking to chemistry is to found only in the very simple and easily understood theory of practical business. The situation is not difficult unless we are unreasonably disposed to make it so.

For a complete text of both addresses the reader is referred to *Metallurgical and Chemical Engineering* for October 15, 1917.

## This Month's Abstracts

An interesting discussion on the fatigue of brasses, especially under alternating stresses, is presented in an abstract of a paper by Dr. R. Archer Haigh before the Institute of Metals. One of the interesting conclusions to which the author comes is that the nature of elongation produced in copper is the same, no matter whether produced by a pulsating or steady stress. It also appears that the value of the ratio between the limiting maximum stress for 1,000,000 cycles and the ultimate tensile stress of the metal is highest for those metals which show considerable reduction of area at fracture in the tensile strength test.

In the section Fuel are presented, in the form of a table, some of the data of tests of a powdered-coal-fuel installation for steam generation on a Western railroad, showing that it is fully possible to burn powdered fuel commercially.

Fred B. Seely, in a Bulletin of the Engineering Experiment Station of the University of Illinois, presents data of a very interesting investigation on the effect of mouthpieces on the flow of water through a submerged short pipe.

That a short stroke is conducive to an increased life of a die is the claim made by E. F. Creager, who supports it by data of his particular experience. He also gives some valuable pointers on the design of presses and describes the little-known devices for oiling the steel strip before punching.

In the section Mechanics attention is called to the abstract of an article by W. M. Wallace on the critical speeds of loaded shafts, in which is discussed the case of a shaft carrying two symmetrically disposed similar cast-iron disk loads.

From data given out by the Society of Automotive Engineers are reproduced a brief description and illustration of the United States military truck, commonly known as the Liberty truck. The history of this engineering achievement was fully told in the daily press. Data contained in the present abstract will give an idea of the simplicity and expediency of the general features of its design.

In the section Pumps are given two abstracts dealing with air pumps. We have reference to tests carried out at the Carnegie Institute of Technology on a small Roots pump, with the view of determining the quantity of air which such a pump can handle. The second article gives some data of tests of a Breguet condenser pump previously described in the Engineering Survey.

The stresses in digester shells have been investigated by H. O. Keay, Mem.Am.Soc.M.E. These stresses are of interest because, in the case of a digester in addition to the pure steam stresses, the effect of the heavy masonry present has also to be considered.

# REVIEW OF ENGINEERING PERIODICALS

SUBJECTS OF THIS MONTH'S ABSTRACTS


Cast Iron in Metal Molds.
Fatigue of Brasses.
Behavior of Brasses under Alternating Stresses.
Soft Copper Wire under Alternating Stresses.
Nature of Elongation under Alternating Stresses.
Fatigue of Brass and Action of Corrosive Fluids.
Pulverized Fuel for Steam Generation, Tests.
Furnace, Grate and Boiler Losses with Pulverized Fuel.
Effect of Mouthpieces on the Flow of Water through a Submerged Short Pipe.
Coefficients of Discharge for Short Pipe with Inward-Projecting Entrance.
Vickers System of Solid Injection for Diesel Engines.
Press Stroke and Life of Die.
Steel-Strip Oiling Device.
Grinding Cutters in Position.
Setting Cutters in a Press.
Critical Speed of Loaded Shafts.
Disk-Wheel Stress Determination, Charts.
Liberty Military Truck.
Rotary Air-Pump Tests.
Breguet Ejectair Tests.
Shrinkage Allowance for Locomotive Tires in U. S. and England.
Stresses in Digester Shells.
Wall Construction of Boiler Setting, Ashley Street Station.
Female Labor in the Automotive Industry.
Metal Industries in France in Wartime.


## Engineering Materials

Structure of Cast Iron in Metal Molds, Edwin F. Cone

A discussion of the structure of cast iron in metal molds as compared with that in sand molds.

That there must be a decided difference between the microstructure of cast iron cast in sand molds and cast in a metal mold, especially a rapidly revolving one, is evident. This matter becomes of particular importance as it has been demonstrated that it is possible to make cast-iron pipe in rapidly revolving molds.

Metal-mold pipe is manufactured by pouring hot metal into a rapidly revolving mold and removing the casting as soon as it has become solid. Under these conditions the crystal formation proceeds in a different manner from that in sand-cast pipe where the crystals are given time to develop slowly.

An examination of samples of the two types of pipe have shown that in the case of the chilled pipe the sample does not represent the chill, but only the average of nearly the entire metal section. Comparing the machine-cast with the sand-cast pipe samples, it is noticeable that the combined carbon is less, due to the amount of pearlite present caused by the conditions of cooling.

A comparison of the photomicrographs of the two types of metal given in the original article tends to indicate the superiority of machine-cast metal from the point of view of crystalline structure. The crystals are smaller and more closely knitted together, while the graphite is in smaller flakes and not in long plates. (*The Iron Age*, vol. 100, no. 12, September 20, 1917, pp. 656-658, 18 figs., *ec*)

Experiments on the Fatigue of Brasses, Dr. R. Archer Haigh

Description of an extensive series of experiments the purpose of which was to ascertain the effects of annealing, using stresses alternating between equal intensities of direct pull and push; to ascertain the relation between the limiting range of stress required to produce fatigue and the ratio between the maximum and minimum stresses; to study the phenomena of elongation under stresses greater than the fatigue limit but less than the ultimate tensile strength of the material; and, finally, to study the influence upon the endurance of the metal under the alternating stresses of corrosive reagents in contact with the metal.

The paper describes the method of testing and the machine used. The brasses used in these experiments were obtained from commercial supplies and not specially manufactured for the purpose.

The data are given in the form of tables and curves. The most interesting part of the investigation refers to the alternating-stress tests.

It was found that under alternating stresses varying between

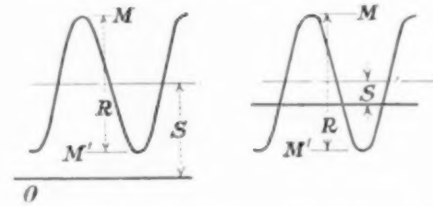



Fig. 1 Diagram of Stresses in a Specimen Tested in an Alternating Stress-Testing Machine

equal intensities of pull and push with a frequency of 2000 per min., the behavior of these brasses was very similar to that of mild steel tested in the same manner. The limiting fatigue stresses were, however, somewhat lower and the results, in general, somewhat more consistent between different specimens of the same sample; likewise, the fractures were, as a

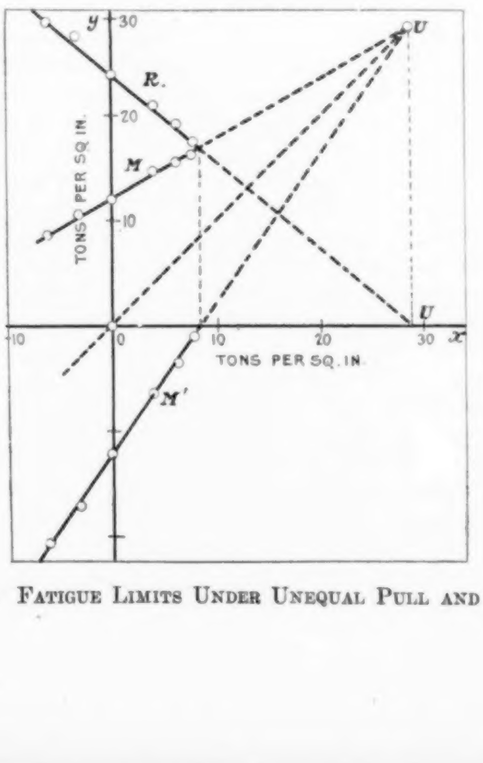



Fig. 2 Fatigue Limits Under Unequal Pull and Push

rule, somewhat more regular in profile. One of the interesting features observed in considering the microstructure of brasses was that the cracks produced in brasses of sound structure showed the "branches" that are commonly observed in mild steel. Further, it was found that under test conditions the growth of the crack was exceedingly rapid. That this is not so in practice may be due to the variability of the stresses at work.

Among other things it has been found that there is no direct proportionality between the limiting fatigue and the primary elastic range in tension and compression. On the whole, the most regular ratio of comparison appears to be the ratio between the limiting fatigue stress and the ultimate strength of the metal. Further, the use of this ratio has the advantage of conveying useful information without implying the existence of any definite physical relation between the two quantities.

The experiments are claimed to illustrate, although they cannot prove, a simple working rule which seems to have few exceptions, namely, that the value of the ratio between the limiting maximum stress for 1,000,000 cycles and the ultimate tensile strength of the metal is highest for those metals which show considerable reduction of area at fracture in the tensile-strength test. It is not intended to imply, however, that a physical connection exists between the two, except in so far as both may be dependent on the same characteristics of the micro- and submicro-structure.

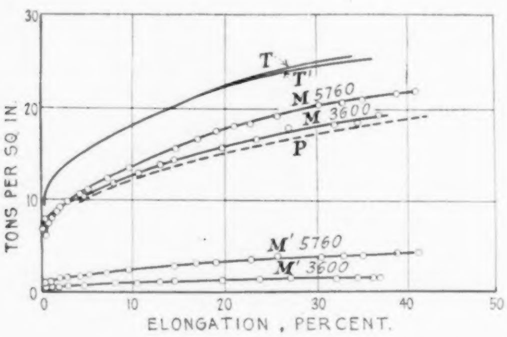



Fig. 3 Ductile Elongation of Brass Wire Under Alternating Stresses

A series of tests was made to ascertain the relation between the limiting fatigue range and the ratio between the unequal maximum intensities of direct pull and push. The curves obtained, as, for example, in Fig. 2, were found to be asymptotic to values which may be regarded as nearly equal to the fatigue limits below which fatigue would not occur after an infinite number of repetitions of stress. In Fig. 2 the abscissæ give the mean stress, and the ordinates for graph $R$ the limiting fatigue ranges, and for graphs $M$ and $M'$ the maximum intensities of pull and push. It appears that plotted in this manner the stresses obey the linear law which may be expressed as

$$R = R_0 - kS$$

$$M \text{ or } M' = (S \pm \tfrac{1}{2} R) = S \pm \tfrac{1}{2} (R_0 - kS)$$

The graphs $M$ and $M'$ represent here the limiting conditions of stress above which fatigue occurs by the production of a brittle fracture, but when the range of stress is greater than that represented and is combined with considerable steady pull or push, failure may also occur by the gradual elongation or compression of specimen. The same material was tested under pulsating stresses with frequencies of 5700 cycles and 3600 cycles per min. Here again the yield point was observed to be somewhat indefinite, but above the yield point elongation was produced at definite stresses lying within limits of measurement.

In Fig. 3 the maximum and minimum intensities $M$ and $M'$ are plotted on the base of elongation used for the tensile tests, Fig. 1. Comparing the curves, it seems at first sight that the change in frequency has produced considerable effect, but the difference between the maxima for the two frequencies may be attributed to the differences betwen the two minima employed. By varying the minimum while the test was in progress, it was found that any given increment to $M'$ required a corresponding but similar increment to $M$ to produce elongation. Careful measurements showed that increment to $M$ was from one-half to one-third of that to $M'$. Assuming either of these values, one may deduce from $M$ and $M'$ the value of an "equivalent" pulsating stress which with zero as the minimum of its cycle would produce the same elongation. The approximate locus of this "equivalent" pulsating stress is represented in the diagram by the curve $P$, somewhat below $M$. The ordinates of $P$ are nearly alike for tests with the different frequencies and are approximately two-thirds of those of the curves representing the tensile tests.

Similar tests have been carried out on soft copper wire. It was found that although the yield point under pulsating stress is nearly equal to that under steady tension, further elongation is produced with considerably less increase of load than in an ordinary tensile test; also that the ultimate elongation produced in copper is considerably greater under pulsating stress (46 per cent) than under steady stress on the same material (34 per cent).

Further experiments have shown that the nature of the elongations is the same no matter whether produced by a pulsating or steady stress. Another interesting fact which has been brought out by the tests is that although some 500,000 cycles of stress were imposed on individual specimens in the course of the elongation tests, no examples of brittle fatigue were found, except in rare instances at the end attachments. It may be inferred that if the range of stress is less than the maximum tension (80 to 90 per cent) the fatigue limit lies above the yield point for pulsating stress. In practice the actual range at particular points in a complex structure may, however, be greater than the mean range is generally estimated, so that fatigue may occur although the estimated range is well below the maximum tension.

An interesting series of tests was carried out for the purpose of ascertaining whether fatigue was accelerated by the presence of different corrosive fluids in contact with the metal during the test. On the whole, it was found that no appreciable acceleration of fatigue had been produced by any of the corrosive reagents employed. On the other hand, it is believed that fatigue may vary readily in parts that have suffered appreciable corrosion prior to the application of the stresses that effect the failure. The phenomena occurring in specimens tested under alternating stresses may differ, however, from those of normal corrosion, in that they occur only locally and with much greater rapidity. Chemical action is certainly accelerated by strain in the crystals even below the elastic limit; and the elongation of stress facilitates the formation of crevices and progressive corrosion throughout the mass. It appears also that the atmosphere as well as fluid reagents may act chemically upon the metal. (Paper read before the Institute of Metals, September 19, 1917, abstracted from a reprint in *The Engineer,* vol. 104, no. 2699, September 21, 1917, pp. 315-319, 23 figs. *eA*)

## Fuel

### Pulverized Fuel in a Power Plant on the Missouri, Kansas & Texas Railway, R. H. Collins and Joseph Harrington, Mem.Am.Soc.M.E.

Description of a plant burning pulverized coal under boilers and of tests thereon, the latter including data on the method used in weighing coal which are of interest.

The data of the tests are given in the form of tables. Of particular interest is the heat balance. The boilers were found to be quite efficient under the conditions of the test, and the furnace and grate extremely so (Table 1), no loss being shown as due to combustible in the ash. The ashpit in this case had a sloping bottom and was visible throughout its extent from the door in the basement. The ash mostly fused and ran down the bottom in molten streams. Practically no dust in the ashpit was encountered, while under the ordinary operating conditions in this plant with the same fuel and operating at times at low ratings there is produced a mixture of fine sandy-looking ash and melted slag.

TABLE 1 DATA OF TESTS OF A POWDERED-COAL-FUEL INSTALLATION FOR STEAM GENERATION ON THE M. K. & T. RR.

| | B. t. u. | Per cent | B. t. u. | Per cent | B. t. u. | Per cent |
|---|---|---|---|---|---|---|
| **Furnace and Grate Losses** | | | | | | |
| **Heat** loss due to combustible in ash | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| **Heat** absorbed by excess air up to temp. steam | 50 | 0.57 | 100 | 0.83 | 67 | 0.53 |
| **Heat** loss due to production of CO | 75 | 0.86 | 44 | 0.37 | 0 | 0.00 |
| **Heat** available for boiler | 7707 | 87.05 | 10821 | 89.68 | 11548 | 91.75 |
| **Furnace and grate efficiency** | .... | 98.40 | .... | 98.69 | ...... | 99.44 |
| **Boiler Losses** | | | | | | |
| **Heat loss due to theo. gas. moist. and H. above temp. steam** | 465 | 5.25 | 438 | 3.64 | 675 | 5.36 |
| **Heat loss due to air leakage through setting** | 120 | 1.36 | 29 | 0.24 | 52 | 0.41 |
| **Heat loss due to radiation and unaccounted for** | 2049 | 24.27 | 3362 | 27.89 | 2056 | 16.33 |
| **Boiler efficiency** | ...... | 65.82 | ...... | 64.61 | ...... | 75.90 |
| **Combined efficiency** | ...... | 57.32 | ...... | 58.00 | ...... | 69.64 |
| **Ratio: Comb. effy. to highest theo. efficiency** | ...... | 64.80 | ...... | 63.90 | ...... | 75.49 |

**During the tests there was a light gray haze apparent at the top of the slag. A sample of this dust was obtained from the breeching. Analysis showed that there was 2 per cent of combustible matter in the fine dust, which showed that the loss in this item was exceedingly small.**

Another matter worthy of attention is the item of heat absorbed by excess air. The $CO_2$ content in the flue gases could without the slightest difficulty be carried up to 16 per cent, readings frequently going to 17 per cent and but few readings being less than 15 per cent. It was found that the CO loss was in direct proportion to the length of the flame, which indicates some relation between the proportion of volatile matter in the fuel and the CO loss.

The furnace conditions in this case were as nearly ideal as one could imagine. The unaccounted-for loss in this test is also the least and the furnace efficiency the greatest.

The question of control of the furnace temperature and consequent fusing of the brick walls has been hitherto a mooted point in connection with the burning of powdered coal under steam boilers. In this instance careful measurements checked in several ways have shown that the temperature of the furnace was between 2300 and 2400 deg. fahr., under which conditions brickwork may be maintained indefinitely, and which is above the fusing point of the ash from a great many coals. Actually, there was no apparent fusing of the brickwork, which might occur if the ash had a fluxing effect thereon. The furnace has been in constant service for nine or ten months and the interior seems to be in perfectly good shape.

On the whole, the writer believes that these tests give promise of a future for powdered coal in steam generation which is indeed bright. It is possible to burn in this way qualities of coal which are not ordinarily classed as of commercial value. Moreover, it is entirely possible to provide space adequate for the complete combustion of fuel in this form and control the temperature of the furnace properly. (*General Electric Review*, vol. 20, no. 10, October 1917, pp. 768-777, 3 figs., *de*)

## Hydraulics

### The Effect of Mouthpieces on the Flow of Water Through a Submerged Short Pipe, Fred B. Seely

**Data of experiments on the flow of water through a submerged short pipe with and without entrance and discharge mouthpieces of a variety of angles and lengths. This investigation treats of the loss of head which occurs when a stream contracts or expands under differing conditions of flow and emphasizes the marked effect that turbulence of flow may have upon the amount of head lost. The discussions have a direct bearing upon various problems in hydraulic practice which involve the contraction and expansion of stream in flowing through passages.**

**Comparatively little experimental work has been done to determine the value of conical mouthpieces of various angles and lengths in reducing the lost head at the entrance to and discharge from a submerged pipe, particularly for mouthpieces of the sizes and proportions comparable with those met in engineering practice.**

**The loss of head due to the contraction and expansion of a stream may be of considerable importance in a variety of hydraulic problems; for example, the passages through a large valve, the passages through locomotive water columns, the draft tube to a turbine, the connection from a centrifugal pump to a main, the venturi meter, the suction and discharge pipes of dredges and the guide vanes and runner of a turbine.**

Losses due to this cause are difficult to estimate and easy to overlook. Even where such losses are, in themselves, of little consequence as compared with other quantities involved, they may have a considerable influence upon subsequent losses on account of the turbulent motion started by the contraction or expansion, and the writer cites several instances where this apparently takes place.

In the present investigation the values of the coefficients of discharge for the short pipe with inward-projecting entrance (no mouthpiece attached) were determined with special care since the effect of attaching the mouthpiece could not otherwise be found. The values found for $c$ are slightly larger than those generally given in textbooks, while the values for $m$ are considerably smaller. This may, however, depend on various concomitant factors.

To illustrate the method of handling the various important

problems in this investigation an abstract will be given of the part relating to entrance mouthpieces. From Fig. 4 it will be seen that entrance mouthpieces having angles of from 10 deg. to 30 deg. (20 deg. to 60 deg. total angle of convergence) give practically the same discharge, while all the entrance mouthpieces having angles of from 5 deg. to 60 deg. give only about 5 per cent range in the rate of discharge. In other words, the lost head at the entrance to an inward-projecting short pipe may be reduced from 0.62 of the velocity head in the pipe to 0.18 of the velocity head by a conical mouthpiece having an angle ranging from 10 to 30 deg.

It has also been found that no advantage results from increasing the length of the entrance mouthpiece beyond that corresponding to an area ratio of from 1 to 2. The lost

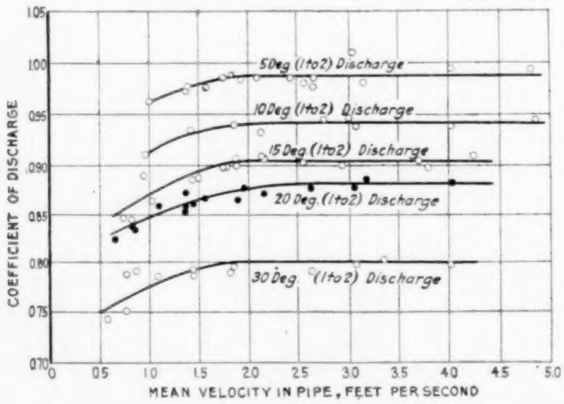



Fig. 4 Relation Between Coefficient of Discharge for a Short Pipe with Mouthpiece and the Mean Velocity in the Pipe

head at the entrance to a mouthpiece is sometimes considered the same as would occur at the entrance to an inward-projecting pipe of the same area as that of the mouthpiece, that is, the lost head is found by multiplying the velocity head at entrance to the mouthpiece by the coefficient for an inward-projecting pipe. The writer does not approve of such a method, since the entrance mouthpiece having an area ratio of 1 to 3 gives almost the same lost head as one with an area ratio of 1 to 2, while the velocity head at entrance to the former mouthpiece would, of course, be only one-ninth of that of the latter. It is not clear just what effect straight throat or pipe has when added to an entrance mouthpiece.

Owing to lack of space only the most important conclusions of the present investigation can be reproduced here.

*a* As applying to conditions likely to be met in engineering practice, the value for the head lost at the entrance to an inward-projecting pipe (i. e., without entrance mouthpiece and not flush with wall of the reservoir) is 0.62 of the velocity head in the pipe ($0.62v^2/2g$) instead of $0.93v^2/2g$, as usually assumed. To put it in another form, the coefficient of discharge for a submerged short pipe with an inward-projecting entrance is 0.785 instead of 0.72, as given in nearly all books on hydraulics. Further, the lost head at the entrance to a pipe having a flush or square entrance is 0.56 of the velocity head in the pipe ($0.56v^2/2g$) instead of $0.49v^2/2g$, as usually assumed. In other words, the coefficient of discharge for a submerged short pipe with a flush entrance is 0.80 instead of 0.82 as given by nearly all authorities.

*b* The loss of head resulting from the flow of water through a submerged short pipe when a conical mouthpiece is attached to the entrance end may be as low as 0.165 of the velocity head in the pipe ($0.165v^2/2g$) if the mouthpiece has a total angle of convergence between 30 to 60 deg. and an area of ratio of end sections between 1 to 2 and 1 to 4 or somewhat greater. In other words, the coefficient of discharge for a submerged short pipe with an entrance mouthpiece as specified above is 0.915.

*c* The loss of head which occurs when water flows through a submerged short pipe having an entrance mouthpiece varies but little with the angle of the mouthpiece if the total angle of convergence is between 20 and 90 deg. and if the area ratio is between 1 to 2 and 1 to 4 or somewhat more. The loss of head for any mouthpiece within this range would be approximately 0.20 of the velocity head in the pipe ($0.20v^2/2g$). There is, therefore, little advantage to be gained by making an entrance mouthpiece longer than that corresponding to an area ratio of 1 to 2. Thus, an extrance mouthpiece with a total angle of convergence of 90 deg. and the length of which is only 0.2 of the diameter of the pipe gives approximately $0.20v^2/2g$ for the loss of head.

*d* The amount of velocity head recovered by a conical mouthpiece when attached to the discharge end of a submerged short pipe depends largely upon the angle of divergence of the mouthpiece, but comparatively little upon the length of the mouthpiece. This is true for lengths greater than that corresponding to an area ratio of 1 to 2 and for total angles of divergence of 10 deg. or more. The amount of velocity head recovered decreases rather rapidly as the angle of divergence increases from a total angle of 10 to 40 deg. At or near 40 deg. the amount of velocity head recovered rather abruptly falls to approximately zero.

*e* A conical discharge mouthpiece having a total angle of divergence of 10 deg. and an area ratio of 1 to 2, when attached to a submerged short pipe, will recover 0.435 of the velocity head in the pipe, which is 58 per cent of the theoretical amount possible of recovery.

*f* The amount of velocity head recovered by a diverging or discharge mouthpiece when attached to a submerged short pipe is considerably more when a converging or entrance mouthpiece is also attached than it is when the entrance end of the short pipe is simply inward-projecting (no mouthpiece attached). This excess in the velocity head recovered diminishes rather rapidly as the angle of discharge mouthpiece increases, and it becomes zero for a discharge mouthpiece having a total angle of divergence of approximately 40 deg. This increase in the velocity head recovered is probably due to the effect of smooth flow in the pipe as the water approaches the discharge mouthpiece. The smooth flow allows the mouthpiece to recover more of the velocity head in the pipe than when a more turbulent flow exists; this increase amounts to as much as 33 per cent in the case of the discharge mouthpiece having a total angle of divergence of 10 deg. and an area ratio of 1 to 2. (*University of Illinois Bulletin*, vol. 14, no. 35, April 30, 1917, 48 pp., 14 figs., *eA*)

## Internal-Combustion Engineering

### Vickers System of Solid Injection for Diesel Engines

It has been mentioned in the engineering papers that Vickers, Ltd., of Barrow, have been using solid injection of fuel with their four-cycle type submarine Diesel engines. This system enables them to dispense with high-pressure injection air, but has the disadvantage of giving a higher fuel consumption, sometimes as high as 10 per cent in excess of that required with good air-injection systems.

In view of the secrecy hitherto maintained about this system, the following data taken from a British patent are of interest:

The fuel is delivered by a pump $M$ (Fig. 5) giving constant fuel pressure, and the power of the engine is controlled by varying the period of opening of the injection valve $G$ by an adjustable lever $J$ operated by a cam $H$, the shape of which is so related to path given to the end of the lever by the adjustment that for all adjustments and consequent variations in engine power the valve is timed to open at the correct point at which injection should take place. Independent timing means are therefore dispensed with, the cam being formed to give the proper timing for the operation of the valve for all variations in the period of opening.

The pump is of a larger capacity than is required by the engine, and surplus fuel is discharged through the adjustable relief valve. The control of the suction of the pump, however, allows the output of the pump to be regulated as the power of the engine is varied. Excess fuel is always delivered by the pump, so that the pressure to which the relief valve is adjusted is maintained. But the excess over that required by the engine is kept approximately constant, thus assisting the

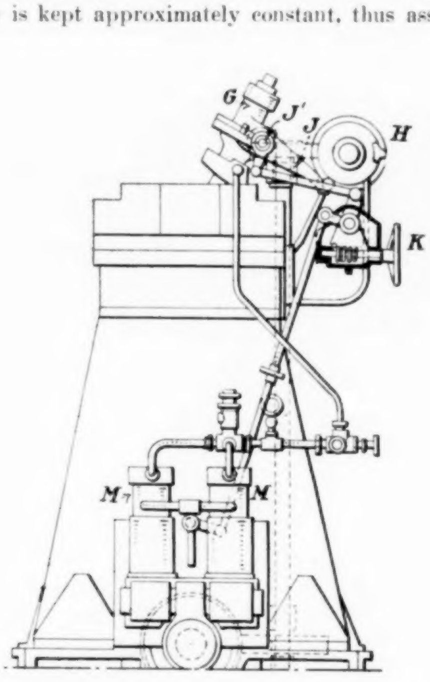



FIG. 5 VICKERS METHOD OF SOLID INJECTION OF FUEL FOR DIESEL ENGINES

relief valve to maintain a steady pressure. This connection to the fuel pump is particularly desirable for constant-speed engines; for example, those driving dynamos, in which the surplus to be passed by the relief valve would otherwise be greatly increased while running at light loads. (*Motorship*, vol. 2, no. 10, October 10, 1917, p. 13, 1 fig., *d*)

## Machine Shop

RELATION OF PRESS STROKE TO THE LIFE OF A DIE, E. F. Creager

The writer attempts to answer the question as to whether a short stroke that is less than standard increases the life of punch and die. He made some experiments and found that decreasing the stroke of the press increases the life of punch and die.

The work the writer was engaged in was that of punching armature laminations. With a " solid " type of punch and die made from the best steel available, the production between grinds was on an average of from 12,000 to 15,000 blanks, both figures with the standard 2½- and 3-in. strokes. Next the same punch and die set was transferred to a press with a 1½-in. stroke and immediately it gave 40,000 blanks before the fin was as bad as it was in the longer-stroke press at 12,000 to 15,000 pieces. At the same time it was found possible to double the output from the same set of dies while maintaining a higher standard of product.

This is a very important saving, considering the fact that it takes from 67 to 76 hours to make the punch, while the completed die mounted for the press takes 270 hours. There are also other savings from the longer life of the punch and die besides those mentioned above.

The article also discusses some of the details of press construction. For example, the fact is mentioned that it would not cost much to secure the key in the brake wheel, and still the writer has seen at least two accidents caused by the key dropping out and allowing the release to strike the stop pin hard enough to break it off and permit the press to repeat. The proper way is to drill and tap the brake wheel over the key and countersink the key slightly, then use two headless set screws, one acting as a lock.

FIG. 6 STEEL-STRIP OILING DEVICE

The writer also thinks that the many unnecessary bends on the pedal rod in some presses and its general flimsiness in others are the wrong way to economize. All presses should be supplied with the non-repeat trip that can be used or not, as desired, and all presses should be guarded at the crankshaft where it approaches the cam.

Fig. 6 shows a simple, little-known device for oiling the strip before punching. Formerly three men with brushes did this work. Now one operator does it with no decrease of speed, no increase of cost, and a saving of approximately 60 per cent of oil.

The writer also recommends a motor-driven shear roll grinder to grind the cutters in position.

It will greatly reduce the twist in the sheet and facilitate handling in the press, if care is used in setting the cutters for depth so that they will shear instead of tear. Cutters ground in position will last five times as long between grinds and the total life will be at least as much longer. (*American Machinist*, vol. 47, no. 12, September 20, 1917, pp. 485-487, 7 figs., *dp*)

## Mechanics

### On the Critical Speeds of Loaded Shafts, W. M. Wallace

Data of experiments arranged for the purpose of examining (1) the accuracy of various simple methods of determining the whirling speed of a shaft of variable sections, and (2) the effect of radial clearance at the bearings on the whirling speed.

A previous article (*The Engineer*, June 16 and 23, 1916, compare The Journal, August 1916, p. 673) indicated a graphic method of estimating the whirling speed of a symmetrical shaft loaded at the middle with a single disk load. In that simple case there was, of course, no appreciable gyroscopic action on the shaft. In the present case the test was made with two similar cast-iron disk loads, fixed symmetrically on the shaft in the positions shown in Fig. 7. The shaft was supported at the sections $A$, $A$ by simple cast-iron bearings, so arranged that the surface of contact of shaft and bearing was limited to a ring of 1/4-in. breadth, and, as the shaft was a nice turning fit in this ring, the positions of the nodes were known almost to one-eighth of an inch.

In Fig. 7 the bending-moment diagram for the loaded shaft is shown by $a\ b\ c\ d$, and the diagram reduced to suit the similar section of the shaft in $a\ e\ f\ g\ h\ l\ m\ n\ r\ d$; the deflection diagram (only half of which is shown) is $p\ e\ t$.

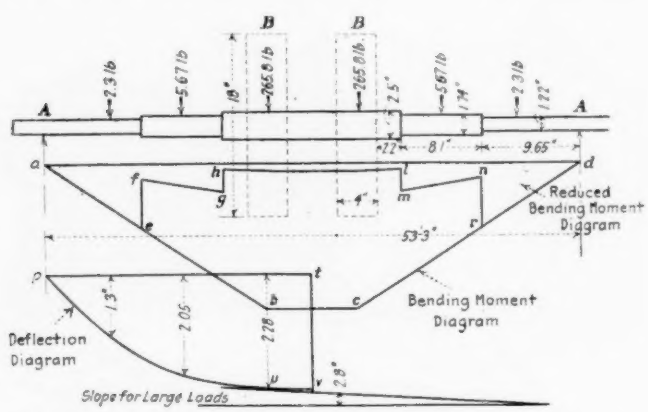



Fig. 7 Bending-Moment and Deflection Diagrams of a Symmetrical Shaft of Variable Section, Freely Supported on Ring Bearings and Loaded with Two Cast-Iron Disks $B$ $B$

The writer makes the calculation in detail, and shows that when working with four-figure logarithmic tables no appreciable difference is seen in the results, as far as gyroscopic action is concerned.

When this shaft was actually running, it commenced to whirl at 663.6 r.p.m., and continued until a speed of 680 r.p.m. was reached; the maximum whirl appears to have occurred at a speed of 677 r.p.m. The calculations carried through by the author indicate that the whirling speed, with gyroscopic action neglected, should have occurred at 687.5 r.p.m., or about 1.5 per cent above the speed actually found by experiment. This difference may be due to experimental error, or, more probably, to the slight difference in diameter of shaft and bearing, a difference which must always occur where a shaft turns freely in its bearing.

The writer checks these figures by a rapid approximate method, using the deflection tables for a uniform shaft, previously described in *The Engineer*, and finds a value for the whirling speed for the shaft of variable section shown above of 695 r.p.m. Since, however, this method is known to tend to give results on the high side, it appears that the correct theoretical whirling speed is about what the graphical method indicates, or 688 r.p.m.

An interesting feature of these experiments, both with and without bearing clearance, was the difficulty experienced in obtaining a true whirl of the shaft. Under the action of hammer blows along the line $X$-$X$, Fig. 8, the cast-iron stands which are fixed at the base to a massive iron bed yield slightly, with the result that on speeding up the shaft horizontally, vibrations first made their appearance, which died down as the speed was increased, to be succeeded by vertical vibrations. This experience suggests the possibility that as soon as it is unlikely that the clearance and yield of bearings is rarely the same in these two directions, the shafts of most machines do not whirl at any speed, especially if the noise produced is considerable.

A series of tests was also carried out in order to determine the effect of radial clearance by the bearings on the whirling speed. To do this the shaft was dismounted and the ends turned down at the sections of support $A$, as shown in Fig. 9, so as to form a diametral clearance of 0.044 in.

A simple theory offered in *The Engineer*, September 1, 1916, anticipated that the clearance would lower the whirling speed and increase the range of speeds over which whirling would occur.

Figs. 10 and 11 may be used to explain the leading lines of this theory. Here the exceptionally thin shaft is shown whirling with the radial clearance $\beta$ at the bearings. The deflection of the shaft at any given point being $y$, the potential or strain energy stored in the shaft is proportional to $y$, but the radius of the circle of whirl described by the shaft at this point being

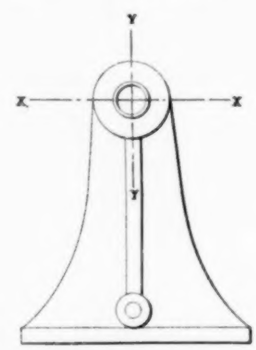



Fig. 8 Bearing for Shaft Shown in Fig. 7

$y + \beta$, it follows that the kinetic energy of motion is proportional to $(y + \beta)^2$; that is, instead of using the summation of $Wy^2$ in the denominator of the experiment for $N$, it is necessary to use the summation of $W(y + \beta)^2$. This, of course, results in a lower value of the whirling speed being obtained.

The writer points out that not only are the magnitudes of the out-of-balance force on the shaft important in affecting the speeds and the amplitudes of vibrations or whirl, but that their disposition on the shaft is also of importance. In most cases in practice, it is a single force situated near the middle of the shaft, a case for which the simple theory indicated above is applicable; still, it is easy to conceive a case in which the clearance effect would only be realized upon end of the bearing.

The writer further claims that the more one studies the actual behavior of shafts, the more one realizes how inadequate, even misleading, is the usual mathematical treatment of the problem.

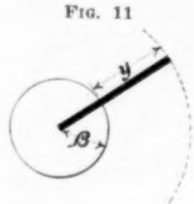
The calculation given by the writer indicates that disturbances should begin at 531.1 r.p.m. On actually running the shaft, horizontal disturbances commenced at about 500 r.p.m There is reason to believe that this very low speed was due to the yield of the bearings in a horizontal direction. The hammer blows along the line $X$-$X$, Fig. 8, have a considerable leverage over the bases of the supports; whereas, the forces along the line $Y$-$Y$ have no such leverage.

The vibrations in a vertical direction commenced and finished at speeds which depended upon whether the speed of rotation was being increased or decreased. On being increased they commenced at 650 r.p.m. and ceased at 680 r.p.m. On coming down they commenced at 650 r.p.m. and ceased at 570 r.p.m. From this data it appears that 570 r.p.m. is the lowest speed at which the vertical forces can maintain (not originate) a rhythmic lifting of the shaft through the clearance distance; that when a disturbance has once been set up it is continued to speeds far beyond those which can be established when the speed variation is in the opposite direction. There is no true whirl, because the maximum vertical disturbance does not occur with the maximum horizontal disturbance.

The writer emphasizes the fact that there is what one might call a certain difference in conception between the mathematical view of critical speeds and what is found in actual practice. The usual mathematical solution gives one the impression that there are certain speeds at which the shaft is in a state of instability so highly sensitive that any slight lateral disturbance would cause a catastrophe. This hypersensitive state exists only in the minds of the mathematicians. Actually, there is a certain range of speed over which the shaft is most

Fig. 9


Fig. 11



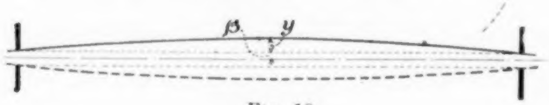




Fig. 10

Fig. 9 End of Shaft of Fig. 7 Turned Down at the Sections of Support $A$ $A$ to Test the Effect of Bearing Clearance

Fig. 10 Illustration of Influence of the Radial Clearance $\beta$ on the Radius of Whirl

Fig. 11 End View of Shaft, Showing Clearance $\beta$

sensitive to out-of-balance force, but by reducing the out-of-balance force sufficiently it is possible to run a shaft quite safely at any speed. (*The Engineer*, vol. 124, no. 3221, pp. 246-247, 7 figs., *et*)

Disk-Wheel Stress Determination, S. H. Weaver, Mem. Am.Soc.M.E.

Reproduction of the paper presented by the writer at the Spring Meeting of The American Society of Mechanical Engineers in May 1917.

In addition to the data presented in the paper before this Society are given several charts for facilitating the derivation of tangential stresses as given in Equations 5a and 5b in the paper. (*General Electric Review*, vol. 20, no. 10, pp. 791-799, illustrated. The charts are on pp. 794-798. *tA*)

## Motor Trucks

### The Building of the U. S. Military Truck

An announcement was made October 8 to the effect that the first Liberty motor truck for the U. S. Army had been completed at Lima, Ohio.

The Liberty motor truck was built in great secrecy. A building without windows and lighted only by skylights housed the truck during the three weeks of its construction. The plant was closely guarded by armed men night and day.

The parts were manufactured elsewhere and as each part was completed it was dispatched to Lima in charge of an army representative, who kept factory officials informed of his progress by telegraph. No one company knows the complete design, or what other companies in various parts of the country made other parts.

In view of this statement officially given out to the daily press, the following data published by the Society of Automotive Engineers become of interest.

The standardized military truck for the U. S. Army was

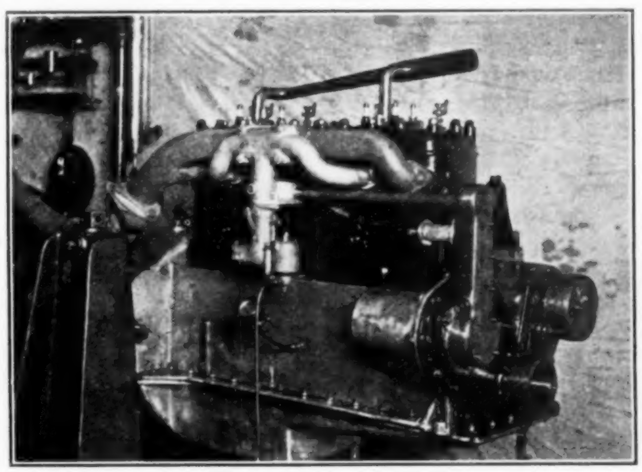


Fig. 12 Liberty Truck Engine

built under the supervision of the Quartermaster Department, Col. Chauncey B. Baker and other officers, with the collaboration of engineers of the various companies.

As regards the engine, it was at first intended to have two types of engines, class A and class B, but it was found that a consistent design of the latter would only be 120 lb. heavier than the design suggested for the former. It was therefore decided to standardize one model for use on both sizes of military truck, the only difference in the two engines being in the bore. It will thus be possible to decrease greatly the number of repair parts needed for the two engines.

The fuel tank will be located on the dash, with provision for a surplus under the seat.

As regards the lubrication system, it was found that the amount of oil passing per unit of time is the determining factor and that this is practically equal in a number of systems operating at widely different pressures. It has been decided to adopt the full-pressure feed with the relief valve at the end of the system. In order to always have the oil in the best possible condition, a method of cleaning it has been developed consisting of passing the oil through a large screen and in having three settling chambers.

The intake and exhaust manifolds of the engine are designed so that heavy gasoline will be thoroughly vaporized. In fact,

it is said that the engine could be operated on kerosene with only minor changes in manifold design.

The transmission is of the four-speed horizontal type and located amidships. Four universal joints will be used in the drive, two between the clutch and transmission and two between the transmission and rear axle. In the design of transmission special care has been taken to secure maximum accessibility and ease of replacement. For instance, only ⅜-in. plugs are used for fastening the covers and bearing retainers. On the right-hand side a handhole has been supplied for inspection purposes.

The truck will have two independent ignition systems for two separate sets of spark plugs. The ignition will be controlled by one switch, so that both ignition systems are either in the " on " or " off " position. A special switch has been designed which carries the lighting and ignition switches and also the ammeter and cowl lamp. The circuit breaker is to be mounted on the back of this switch. The generator is of the third-brush type, normally giving eight amperes at 750 r.p.m. It is driven by an Oldham coupling.

As regards the rear axle on class B truck, it will be of the worm-gear type on account of the great manufacturing capacity available for producing the sizes of axle necessary for the heavy service. The class A truck will be equipped with an internal-gear axle. The worm-gear axle has been refined and simplified. For instance, only two sizes of roller bearings will be used instead of the five ordinarily required for the full-floating type of axle. The dry plate at the end of the axle is held by bolts instead of studs, as is the usual practice.

As regards production, it is understood that no employee will be engaged without the full approval of the Quartermaster General's Department after consideration of statements as to nationality and former connections. The men who will handle the production work are really drafted for the national service just as much as those who have joined the National Army. But they will carry the work on in the same manner and by the same methods which made them successful in private business.

In working out the design of the Liberty motor truck the Quartermaster Department had the great advantage of the most hearty coöperation on the part of private companies and the Society of Automotive Engineers.

Two experimental units have been completed, and since formally delivered to the Secretary of War in Washington.

**For further details so far published in connection with the design of the Liberty motor truck, the readers are referred to the *Journal of the Society of Automotive Engineers,* vol. 1, no. 3, September, 1917, pp. 173-177.**

## Pumps

### Tests of a Rotary Air Pump

**Data of tests carried out by Professor Trinks of the Carnegie Institute of Technology on a small Roots pump.**

The purpose of the tests was to determine how much air the pump could handle. The air admitted to the pump was caused to pass, previous to entering it, through two tanks, which makes a somewhat cumbersome but necessary arrangement. The reason for this procedure is as follows: If the air going through the pump had been admitted directly through the nozzle at the pump inlet, the pulsation at the pump would have caused the nozzle to show a greater quantity of air flowing than actually did flow. The tanks themselves and the thin rubber diaphragm provided in one of them entirely eliminated these vibrations.

In order to duplicate as far as possible the conditions existing in heating service, the pump in the test was supplied with a small amount of water for sealing purposes. At first the action of the pump was found to be very erratic as it would ultimately hold and lose the vacuum, but it was later found that the trouble lay in the surging back and forth of the sealing water. A check valve was placed in the suction line near the pump and the trouble immediately disappeared. This surging never occurs in practice, because a check valve is usually present.

The more water was admitted the higher was the vacuum which could be maintained by the pump.

Fig. 13 indicates the quantity of air determined by the vacuum which can be maintained by the pump. It expresses

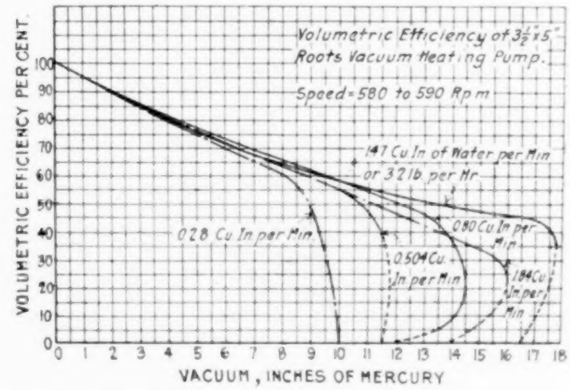



Fig. 13 Quantity of Air Handled by Small Roots Pump Determined by the Vacuum on the Pump

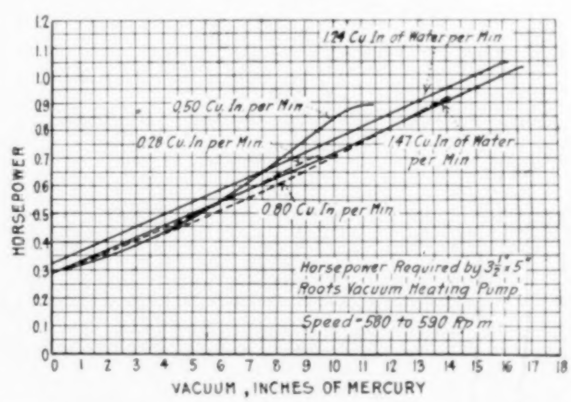



Fig. 14 Power Consumption of a Small Roots Pump under Varying Conditions

the volumetric efficiency of the pump as a function of the vacuum (hence of the quantity of sealing water). By volumetric efficiency is meant the ratio in per cent of the quantity of air actually delivered to the quantity which would be delivered under ideal conditions.

Fig. 14 shows the power consumption of the pump under different conditions, again as a function of the vacuum. It appears that the power varies in a straight line with the vacuum. An operator can considerably increase the power consumption by tightening the stuffing boxes. (*American Gas Engineering Journal,* vol. 107, no. 14/3109, October 6, 1917, pp. 301-302, 3 figs. *e*)

RECENT DEVELOPMENTS IN AIR-PUMP DESIGN, E. Jones

Discussion of the merits of some of the more recent developments in design of air pumps used as auxiliaries to steam machinery.

The writer discusses the comparative merits of the five standard types of condensers, namely, evaporative, ejector, barometric, jet and surface, with particular reference to the latter two. In this connection he gives a table (Table 2) showing the relative costs and requirements of barometric, jet and surface condensers. The conditions which have been assumed are the same for each case, namely, steam quantity, 40,000 lb. per hour; vacuum with barometer at 30 in., 28½ in.; cooling water at 60 deg. fahr.; and for prime mover a high-pressure steam turbine. Under the present abnormal conditions surface condensers are in a particularly unfortunate position, owing to the cost of the materials used for tubes and tube plates, which is approximately 27½ per cent of the value of the whole equipment.

Of the particular designs discussed by the writer, the Breguet condenser is of special interest. It was introduced

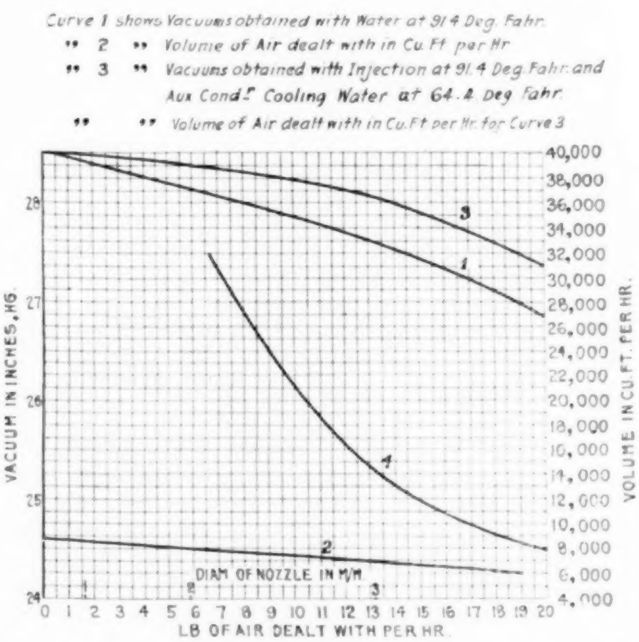



FIG. 15 BREGUET EJECTAIR THEORETICAL VACUUM AT 91.4 DEG. FAHR.

just before the war, and is now said to be extensively applied in the French navy. A description of it was given in THE JOURNAL, 1914, p. 0183. These "ejectairs," as they are called, are designed for working with steam pressures at 55 lb. per sq. in. or above, and with the special arrangements of nozzles lower pressures can be used in the primary ejector.

The curves, Fig 15, show the performance of an ejectair. Steam to the ejectors had an absolute pressure of 125 lb. per sq. in., and the steam consumption is given at 194 lb. per hour, of which 129 lb. are recoverable. The apparatus worked in conjunction with a small jet condenser, dealing with 94 gal. of injection water per min. Curve 1 gives the vacuums obtained with water leaving the condenser at a temperature of 91.4 deg. fahr. (33 deg. cent.), and the auxiliary condenser out of action; curve 2 the volume of air dealt with in cubic feet per hour; curve 3 the vacuums obtained with given air leaks, and the water leaving the main condenser as for cooling water at 66.2 deg. fahr. (18 deg. cent.); and curve 4 the volumes of air dealt with under the same conditions. It was calculated that the air coming in with the injection water and at leaky joints amounted to 1.102 lb. per hour, or 0.5 kg. (*Engineering*, vol. 104, no. 2697, September 7, 1917, pp. 263-265, 9 figs., first installment of a serial, *d*)

TABLE 2 RELATIVE COST AND REQUIREMENTS OF BAROMETRIC, LOW-LEVEL JET AND SURFACE CONDENSERS

| Tyoe of Plant | Consisting of | Approximate Net Weight of Apparatus | Horsepower Required to Drive Condenser and Auxiliaries | Present-Day Costs | Equivalent Ratio |
|---|---|---|---|---|---|
| | | Tons | B.h.p. | £ | |
| Barometric | Condenser, staging, air pump, injection pump, driving motor, switchgear, air and tail piping, main exhaust piping and sluice valve, auto-exhaust valve. Complete erection | 40 | 89 | 2700 | 1.286 |
| Low-level jet | Condenser, water extraction and air pumps, driving motor, switchgear, main sluice valve, adapting and expansion pieces, auto-exhaust valve. Complete erection | 22 | 87 | 2100 | 1.00 |
| Surface | Condenser, rotary air pump, extraction pump and circulating pump mounted on common bedplate with driving motor and switchgear. Necessary interconnecting pipes, main exhaust-steam sluice valve, expansion piece, automatic atmospheric valve. Complete erection | 30 | 78 | 3300 | 1.571 |

## Railroad Engineering

THE SHRINKAGE ALLOWANCE FOR LOCOMOTIVE TIRES, E. L. Ahrons

The writer compares the methods of determining shrinkage allowance on a large English main line with that adopted by the American Master Mechanics' Association and the one adopted by the Lancashire & Yorkshire Railway in England.

In the diagram, Fig. 16, the graphs give the immediate shrinkages for wheel centers of different diameters; A A being the curve for the large English railway, B B the American Master Mechanics' Association standard and C C that of the Lancashire & Yorkshire Railway.

The standard practice of the Great Northern was to allow a shrinkage of 1 in 800. Stress-strain diagrams made from tests of class C—British standard—tire steel of 50 to 55 tons ultimate tensile strength, showed that the elastic limit was reached with an extension of about 0.2 per cent, at 26.5 tons per sq. in. Therefore, an extension of 0.1 per cent, or 1 in 1000, results in a stress on the material of the tire of 13.25 tons per sq. in. The modulus of elasticity of this tire steel will therefore be 13,250.

The diameter of the wheel center was 74 in., and that of the tread of the tire, after shrinkage, where the measurement was taken, was 80 in., the tire being 3 in. thick. It was found that the outside perimeter had extended 0.232 in. after shrinkage on, with an allowance of 1 in 800 on the inside, i. e., on the diameter of the wheel center. The outer circumference, after shrinking, being 251.33 in., the original length of the circumference was therefore 251.098 in., and the strain $e$ = 0.232/251.098. The stress in the outer fiber of the tire = 13,250 $e$ = 12.242 tons per sq. in.

Treating the tire as a ring of rectangular section, and using

Lamé's method of calculating the stresses in thick cylinders, and if

$P_2$ = hoop stress on the outer fiber (= 12.242)

$P_1$ = hoop stress on the inner fiber

$Q_2$ = radial compressive stress on the outer fiber

$Q_1$ = radial compressive stress on the inner fiber of the tire at the surface of junction between tire and wheel center,

the relation between the hoop tension $P$ and the radial stress $Q$ at all points within the tire is $P_2 - Q_2 = P_1 - Q_1$ = constant, and since there is no radial pressure on the outside of the tire, $Q_2 = 0$, and therefore $P_1 - Q_1 = P_2 = 12.242$ tons per sq. in.

On the inner fiber of the tire the usual form of Lamé's expression gives

$$P_1 = Q_1 \frac{R_2^2 + R_1^2}{R_2^2 - R_1^2} \qquad [1]$$

in which $R_2$ and $R_1$ are the outer and the inner radii of the tire and $P_1$ is the apparent hoop tension, neglecting the effect of lateral contraction (Poisson's ratio).

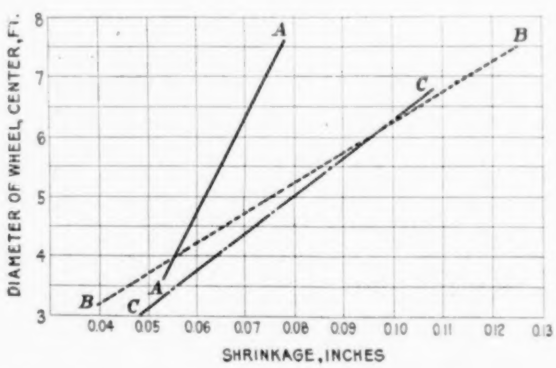



FIG. 16 COMPARISON OF THREE STANDARDS OF SHRINKAGE OF LOCOMOTIVE TIRES

Taking the effect of lateral construction into account, the stress equivalent to the greater strain is

$$P_1 = Q_1 \frac{R_2^2 + R_1^2}{R_2^2 - R_1^2} + \frac{1}{m} \qquad [2]$$

in which $m$ may be taken as 3.5, an average value for steel.

The thickness of the tire is nominally 3 in., but as the outside tread is turned to 80 in. diameter ($R_2 = 40$), the actual thickness is very slightly greater, since $R_1$ is slightly less than 37 in. after shrinkage by an amount depending upon the contraction of the wheel center.

Neglecting for the moment the contraction of the wheel center, the value of $P_1$, the stress on the inner fiber of the tire, becomes from Equation [2] 13.138 $Q_1$, and since from [1] $Q_1 = 12.242 - P_1$, the value of $P_1$ becomes 13.25 tons per sq. in.

The strain on the inside layer of the tire, or the stress (13.25 tons) divided by the modulus of elasticity (13,250), is .001, i.e., the actual or terminal shrinkage is 1 in 1000.

If the wheel center be supposed to have contracted 0.02 in. in the diameter, Equation [2] gives $P_1 = 13.094\ Q_1$, from which $P_1 = 13.255$ tons per sq. in. The effect of the contraction on the stress in the tire may, for ordinary cast-steel wheel centers, be neglected.

The difference between the effective or real shrinkage allowance of the tire and nominal allowance is of interest. In the case cited by the writer this difference amounted to 0.0185 in., which may be taken as the actual contraction of the 74-in. wheel.

It may be of interest to investigate experimentally the question of the amounts of contraction of wheel centers for different diameters. While from the above figures it appears that the maximum stress on the inner fiber of the tire is 13.25 tons per sq. in., it is half the elastic limit of the steel. It may happen that an occasional tire is gaged too tightly, in which case the nominal shrinkage will be considerably higher. The above stress in the tire is static and it is probable that additional alternating dynamic loads may, in time, produce the results of repeated stresses and ultimately cause fracture of apparently sound tire which has been shrunk on under the maximum hoop tension considerably less than the ordinary elastic limit of the material, which would explain certain cases of fracture. (*The Engineer*, vol. 124, no. 3222, September 28, 1917, p. 263, 2 figs., *cp*)

## Steam Engineering

INVESTIGATION OF STRESSES IN DIGESTER SHELLS, H. O. Keay, Mem.Am.Soc.M.E.

In the design of sulphite-digester shells it has long been the practice to calculate the stresses by means of conventional formulæ for cylindrical pressure vessels, without any apparent consideration whatever of the possible action of the masonry lining. Where such a lining reaches a thickness of 7 in. or more, however, there is present a circular arch of considerable strength. This investigation was undertaken with the view to demonstrating that under certain circumstances such linings impose a heavy tensile stress upon the shells of digesters.

To settle the question of influence of temperature of the lining upon shell stresses, Prof. A. P. Mills and the author of the present article were requested two years ago by the Laurentide Co., Ltd., of Grand' Mère, P. Q., Canada, and the International Paper Company, to conduct a joint investigation of the behavior of the shell of a digester under working conditions.

The paper gives a detailed account of the methods of investigation used in the present case and presents the data in the form of curves.

Had no extraneous stresses been encountered, calculation shows that the magnitude of the value of the circumferential stresses (upper curve, Fig. 17) would have been approximately double those of the longitudinal stress (lower curve); but actually such is not the case, nor do the curves return to the base line of zero stress even when the digester has been cooled down to room temperature. Further, the difference between the maximum and minimum of neither the circumferential- nor the longitudinal-stress curve is as great as the calculated values corresponding with the known maximum internal pressure.

This can be accounted for in only one way, namely, that subsequent to the lining of the digester, compression had accumulated in this lining, reacting as a residual tensile stress in the plate. The effect of internal pressure and the elastic extension of the steel shell tend to relieve the compression in the lining and its consequent reaction on the shell. So, at the point of maximum internal pressure the resultant stress is necessarily less than the sum of the residual stress and that which would have been produced by hydrostatic pressure alone.

The residual circumferential stress is shown to be about 5000 lb. per sq. in. of the solid plate, and the maximum circumferential stress in the final cook reaches a value of 13,000 lb. per sq. in. with a corresponding longitudinal stress of 10,400 lb. per sq. in. Since the strength of the longitudinal

seam expressed in terms of the strength of the gross section of the uncut plate is 85.42 per cent, and that of the girth seam 67.19 per cent, the corresponding maximum circumferential stress becomes 13,000/0.8542 = 15,220 lb. per sq. in. and the maximum longitudinal stress 10,400/0.6719 = 15,480 lb. per sq. in. The higher stresses encountered in making the first cook after the digester had been cooled down emphasize the necessity for extreme care in bringing the digester up to working temperature and pressure in similar circumstances.

A series of tests was also run on new digesters selected at the Laurentide Company's sulphite plant for the purpose of determining the strength of the longitudinal seams. These tests gave results fairly consistent with the results of the tests referred to above. The behavior of the digester shells was quite similar, although in the former instance the lining cement was gaged with the sodium silicate at 5 deg. B., while in the latter case the cement was gaged with a similar solution at approximately 36 deg. B., a circumstance which appears to indicate that if the silicate has an influence in producing permanent expansion of the lining, an excess over a certain amount has little or no effect. (*Paper*, vol. 21, no. 4, October 3, 1917, pp. 14, 16, 18, 20, 22, 24 and 26, 10 figs., *e*)

### New Boilers for Ashley Street Station

Data of an additional boiler installation for driving the new 25,000-kva. turbines now being installed in the Ashley Street Station of the Union Electric Light and Power Company, St. Louis, Missouri, and to increase the general steam capacity by about 60,000 kw. to take care of the growing business of the plant.

To do this the 28 Scotch marine and small water-tube boilers located on the first floor of a double-deck boiler plant will be replaced by 24 of the new type of Edge Moor boilers.

The Scotch marine boilers with internally fired furnaces did not prove successful, owing to their being ill-suited to the burning of low-grade Western coals which must be used in the St. Louis district.

The new boilers are equipped with underfed stokers. The installation of such stokers in a power station which must rely on low-grade Illinois coal was a new and somewhat radical departure, but after six months of operation the success of the venture was proved beyond a doubt. Boiler ratings up to 200 per cent are being carried continuously with an over-all boiler and furnace efficiency of 70.5 per cent.

Precision "Three-in-One" air gages are used for indicating draft pressures in the blowers, furnaces, and uptakes. The average draft in the uptake is $1\frac{1}{4}$ in. of water, with that in the furnace slightly below atmospheric pressure, while the available force of the air blast is 4 in. With this equipment it is impossible to obtain ratings in excess of 300 per cent for periods of one hour or slightly longer. On the economizers are "Tycos" double-pen recording thermometers for incoming and outgoing water temperatures. Each boiler is also equipped with a General Electric indicating flow meter calibrated to read directly in hundreds of boiler hp.

Edge Moor boilers are used. They are built up with the side-wall construction shown in Fig. 18. These walls, which have the usual firebrick lining 9 in. thick opposite the furnace proper, are backed up with hollow building tile 8 in. thick bonded in with common red brick. On the outside of the tile is placed 2 in. of air-cell covering securely fastened and cemented in place, then covered with canvas. On the outside of the building tile and beneath the 2-in. covering is placed a coating of "boiler seal," the object of this being to stop up cracks and prevent air leakage through the setting. Six months' operation of the boilers has proved that these settings are entirely satisfactory. (*Power*, vol. 40, no. 15, October 9, 1917, pp. 480-484, 10 figs., *d*)

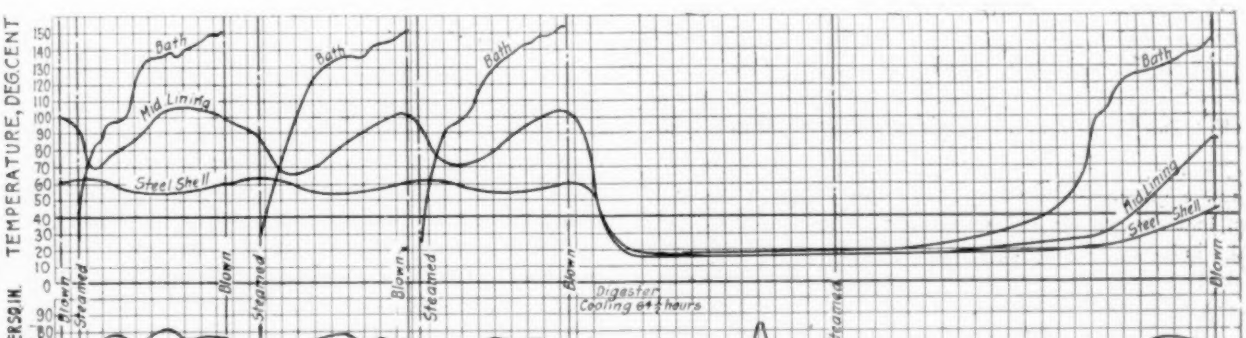



Fig 17 Data of Tests of a Digester Shell for Circumferential and Longitudinal Stresses

## Varia

### Female Labor's Place in the Automotive Industry, Allen Sinsheimer

Discussion of the probability of increase of female labor in industry, based on the experience of England. The author lays great emphasis on the fact that if female labor is employed, proper conditions should be provided, especially with respect to food.

By comparing the increase in the number of women employed in gainful occupations in the United Kingdom with that now employed in America, the writer comes to the conclusion that one may expect an access of more than 2,000,000 into the industry. This condition will create many problems peculiar to female labor and involving such things as illiteracy and lack of knowledge of English; hours of labor; rates of wages and earnings; efficiency of female labor; labor conditions affecting health; housing and safety; industrial canteens; restrooms and matrons; state legislation affecting female labor; feminine temperament; employment of mothers; time keeping and labor turnover; physical capacity.

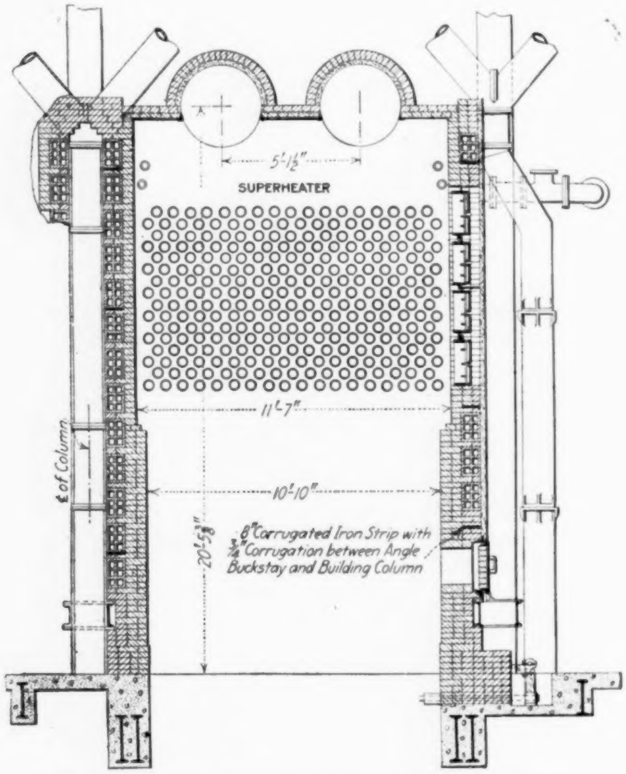


Fig. 18 Wall Construction of Boiler Setting

As regards the knowledge of English, the writer tells of the so-called Sicher plan, which includes a school incorporated with daily work where three-quarters of a hour of daily instruction is given without interruption in factory work. The schoolroom is set aside in a quiet out-of-the-way corner of the factory. The school has the coöperation of the Board of Education. The total cost of 35 weeks' instruction per girl is $16.80 for the firm and $14.80 for the city. It was found that for 32 weeks preceding the opening of the school the wages of the girls who later became pupils averaged 19.5 cents per hour, while that which the literate girls received was 23.2 per hour.

As regards the hours of labor, experiments in this country with female labor confirmed the experience in England, namely, that short-hour shifts are preferable to long-hour shifts. The Miller Rubber Company, of Akron, Ohio, experimenting by reducing the hours of labor from ten to eight, discovered that female labor earnings of 16.4 cents per hour increased to 21.5 per hour in six months, that production increased from 82 per cent to 107 per cent and attendance by 10 per cent in the same period.

As regards efficiency, inquiry among manufacturers in this country shows that female labor applied to certain light machine work and to work where deftness of hand is required is more productive than male labor. The Link-Belt Company of Indianapolis finds women more efficient and productive than men when assembling small links into chains and handling packing for heat-treating purposes. The same experience is reported by several other large concerns, among them the International Harvester Company and the Westinghouse Electric Company.

On the other hand, some manufacturers find that women at machine work require more supervision than men, because when a machine breaks down they are unable to repair it, or because the women are unable to handle the large and heavy output resulting from their productive effort.

Conditions of labor affecting health are of particular importance where female workers are employed. Sanitary washrooms and cloakrooms are essential. Chairs should be provided wherever possible. Provision for meals should allow three-quarters of an hour to one hour, and the interval between meals should not exceed four hours. The housing problem also becomes very important.

The temperament of female labor affects production. Women are less inclined to become labor machines than men. Female supervisors are more efficient than men when handling female labor, because of their ability to gain the workers' confidence, to learn their grievances, to determine home troubles, or discover any factors which prevent them from attaining a normal productive output. On the other hand, the general impression is that women are less inclined to change their positions than men.

The physical capacity of women differs from that of men and they are particularly liable to injury through lifting weights or by long standing. Chief among the slight ailments to which the employers will do well to direct their attention are disturbances of digestion due to unsuitable food, irregular and hurried meals, fatigue, anemia, headache, nervous exhaustion, muscular pain, and weakness and derangement of special physiological functions. English manufacturers have found it profitable to employ women doctors to examine applicants for work. It was found that prolonged standing may be the cause of permanent and serious injury to women, and where standing is unavoidable they make the hours and spells of employment short and provide seats for frequent intervals of rest.

Experiments in the motor plants of the United States show that as test drivers women are more careful than men and that they drive more responsibly through city streets. A number of concerns have found that on assembling, inspection and light machine work women may be employed with excellent results. The Dayton Engineering Company, employing several hundred women workers, has installed a factory school for the girls where they are taught light machine work, receiving the guaranteed day rate while studying.

The writer proceeds to quote the views of Samuel Gompers, President of the American Federation of Labor, on female labor. An interesting part of this is the quotation from the

report of an inquiry carried out by the Federation of Metal Workers of Germany in war times.

From this report it appears that women are often engaged in work which is entirely too strenuous for them and sometimes suffer from the consequences. Thus, the women complain very much of abdominal pains caused by frequently having to lift, without any tackle, sheets weighing 52 lb. In the foundry they have, for instance, to push the casting pans about, work that overtaxes their strength. One woman sustained a rupture of the groin through performing this work. At steam hammers women have to draw bomb castings (weighing about 88 lb.) in a state of incandescence from the furnace to the hammer. It appears that a continuous effort is made in Germany to employ women at the hardest and most dangerous jobs: at steam hammers, shaping machines, core making, pneumatic lifts, transporting heavy cores, casting with pans and with hand ladles. One result of the hard work in one establishment is that out of 42 women nearly one-third have been disabled by disease.

Of the women employed in the metal trades 79 per cent work from 11 to 13 hours per day, with much overtime and Sunday work.

As regards wages, the treatment does not appear to be fair. Thus, in one establishment it is the custom that piece-work wages must not exceed the average time wages by more than 75 per cent. Should a woman through diligence and skill earn a larger sum, the piece-work rate was reduced in her case. The inquiries showed that only 9 per cent of the women were paid at rates corresponding to those paid to men for identical work. (*The Automobile and Automotive Industries*, Nos. 13 and 14, September 27 and October 4, 1917, pp. 525-531 and 592-593, illustrated.)

## The Growth of Mining and Metal Industries in France

BEFORE the war, France was already considered by experts as the richest country of the world in iron ore, after the United States. Besides the basins of Lorraine, which produce three billion tons of ore, she possesses the basin of Normandy, which, in an area of 40,000 square kilometers, contains, according to a recent estimate, nearly a billion tons of a superior quality of ore yielding 50 per cent of iron. In 1914, 21 grants in mining districts, producing 1,152,000 tons a year, already existed in the departments of the Orne, Manche and Calvados, which yielded 648,000 tons with six grants only under exploitation. About the middle of 1916, a large society, entirely French, the Société Normande de Métallurgie, was founded, with a capital of 40 million francs, by Messrs. Schneider and Co., the great Creusot manufacturers, the Société des Aciéries de la Marine et Homécourt, and several shareholders belonging to the metallurgic world. This new society leased the foundries and fittings previously organized, or provided for, by the Société des Hauts-Fourneaux de Caen, formed in 1892, and in July 1916 started the works afresh. They are situated at Mondeville-Colombelle near Caen, and stand over 400 hectares (about 2½ acres), 200 of which are on the plateau and 200 in the valley of the Orne. About thirty kilometers distant is the Soumont mine, capable of yielding even now 4000 tons of iron ore a month, and which, in the near future, will have a far larger output.

The establishments of the Société Normande de Métallurgie comprise gas and coke furnaces, large steel works, a flattening mill, smelting works and blast furnaces. Three stations, and a railway line 33 km. long, facilitate the transport service. The line was made by a branch society and runs between the above foundries and the Soumont mines. At present there are 4 batteries of 42 furnaces each, producing 1000 tons of coke a day. In January 1918 two other batteries, now under construction, will be in working order and will bring the output up to 1500 tons a day, or 500,000 tons a year. The coke, collected by an ingenious system of inclined planes and chains, after being sorted out, is sent in trucks to Government metal works. Gas undergoes a series of processes for the purpose of extracting the secondary products obtained by the distillation of coal such as tar, phenol, benzine, toluol, naphthalin, sulphate of ammonia, used in the manufacture of explosives and for dyeing purposes, and which, prior to the war, were almost exclusively produced by Germany.

The blast furnaces, the first of which has been recently inaugurated, are in themselves 29 meters high, but with their basements tower 45 meters above the foundry ground plot. They can produce 400 tons a day, which is the largest output obtained in Europe up till the present day. To each is affixed a battery of 5 metal cylinders, or "Cowpers," 7 meters in diameter, for heating the air for the combustion of coke, and the reaction of carbon on the oxides of the ore, which is the source of production for cast iron. Three of these gigantic blast furnaces will be ready in the autumn of 1918, and the whole installation, when completed, will allow of an output of 450,000 tons of cast iron a year. The steel works, properly so-called, contain 4 converters of 30 tons, and 5 Martin furnaces of 30 tons, allowing of an output of 275,000 tons of Thomas steel and 125,000 tons of Martin steel every year. The flattening mill can pass 500,000 tons of ingots a year, and is supplied with several reversible trains for the production of all small samples. The Société already possesses stocks of iron ore sufficient to insure the supplies for its factories without any difficulty. It has had a large water tower, 66 meters in height, built in the neighborhood, with two reservoirs and a canal to the Orne, so that 10,000 cubic meters of water could be supplied hourly. A vast hall 200 meters long contains the electric machinery for distributing motive force, two turbo alternating generators of 3000 kilowatts, one of 5000, six gas alternating generators of 6000 hp., and three of 3000 hp. A private harbor has been built on the Orne canal, and it is now ready for vessels of 2000 tons, and will soon be open to boats of 8000 tons' burden.

The preceding facts show how the Société Normande has been able to create in the midst of war one of the most important metallurgic centers in the whole of France. The mining industry of the entire region has followed its example. At present 30 fresh grants have been made for exploiting of the layers of iron in Normandy, Brittany and Anjou. On the other hand, the French Government is preparing to work the Littry coal fields, situated between Saint-Lô and Bayeux. Lastly, owing to many recent improvements, trade with Caen harbor is increasing every day. From 890,000 tons in 1910, it rose to 1,126,000 in 1913.—Paris Chamber of Commerce Bulletin, September 1917.

## CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society. The Editor will be pleased to receive inquiries for further information in connection with articles reported in the Survey.

# SELECTED TITLES OF ENGINEERING ARTICLES

## AERONAUTICS

CHART FOR SAYING FLAT SURFACES OF BOILERS ACCORDING TO LLOYD'S RULES, A. F. Menzies. International Marine Engineering, vol. 22, no. 10, October, 1917, p. 440.

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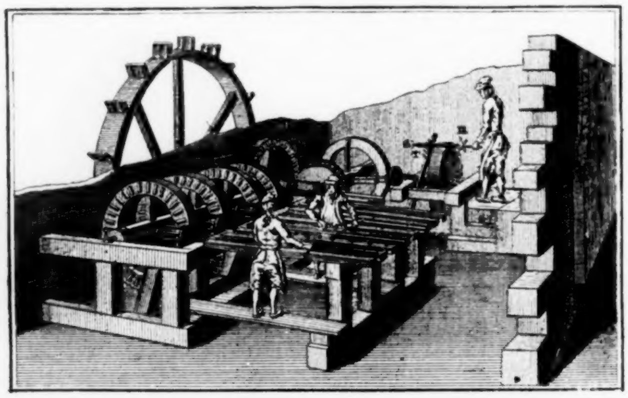
# LIBRARY NOTES

## From the Libraries of the Four Founder Societies and the United Engineering Society, in the Engineering Societies Building, New York City

### Diderot's Encyclopedia

THE United Engineering Society Library has been fortunate in securing a well-preserved copy of the famous French "Encyclopédie" edited by Denis Diderot (Encyclopédie, ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers, par une société de gens de Lettres. Mis en Ordre & publié par M. Diderot; & quant a la Partie Mathématique, par M. d'Alembert . . . 3rd éd. Geneve, Pellet, 1777-1779. 36v., fronts, ports, tables. With 3v. of copper plates.) The Encyclopedia Britannica characterizes this work as one of "greatest and most remarkable enterprises of the 18th century." The germ of the "Dictionnaire" originated in a plan to translate from English into French, Ephraim Chambers' "Cyclopædia," or an Universal Dictionary of Art and Sciences, containing an Explication of the Terms and an Account of the Things Signified thereby in the Several Arts,



HOW THEY MADE MUNITIONS IN DIDEROT'S TIME

The old encyclopedia contains many such illustrations of interest

and the several Sciences, Human and Divine." (London, 1728. 2v.)

After much quarreling between the publisher and those who had undertaken the translation, it was abandoned. An original French work was then planned and Diderot engaged as editor. "Instead of a mere reproduction of Chambers, he persuaded the bookseller to enter upon a new work, which should collect under one roof all the active writers, all the new ideas, all the new knowledge, that were then moving the cultivated class to its depths."

No other encyclopedia, it is safe to say, ever had so stormy, so romantic, and eventful a career. The work was by no means a piece of closet scholarship. Into it was poured the spirit of the democratic and scientific movement just preceding the French Revolution. The encyclopedia burns with the desire of the men of that time to conquer nature. It is aflame with the passion for experiment and exploration. Needless to say, it met with the violent opposition of the powerful ecclesiastics and the despotic French court, who instinctively felt this work to be a menace to blind faith in the traditional explanations of natural phenomena and a challenge of the unthinking worship of autocratic authority. Rousseau wrote the articles on music. Montesquieu, Turgot, and Voltaire were among the more than twenty contributors. Such a galaxy of free spirits did not inspire the trust of the then tottering French feudalism. In 1749 Diderot was imprisoned at Vincennes in close confinement for twenty-eight days, and cooped up in the castle an additional three months and ten days. The first two volumes of the encyclopedia were suppressed "as being dangerous to the king's authority and religion." The plates were ordered seized but could not be found. After work had been resumed, the Parliament of Paris, in 1759, stopped the sale of the Encyclopédie and ordered all copies to be burned. In 1766 Lebreton, the publisher, was forced to show his subscription list and was put in the Bastille for eight days. The famous beauty, Madame de Pompadour, who had befriended the undertaking from the first, pleaded for the lifting of the ban upon it, saying to the king that she could "know no longer how her rouge and silk stockings were made. The duc de la Vallière regretted that the king had confiscated their encyclopedias, which could decide everything. The king said he had been told that the work was dangerous, but as he wished to judge for himself, he sent for a copy. Three servants with difficulty brought in the 21 volumes. The company found everything they looked for, and the king allowed the confiscated copies to be returned." Lebreton, the publisher, set up the copy exactly as it came from the editor, but after final revision secretly removed all parts he felt too bold. It was thus that this great scientific work fared.

Diderot was the contributor of articles on philosophy, the arts and trades. "He passed whole days in workshops, and began by examining a machine carefully, then he had it taken apart and put together again, then he watched it at work, and lastly worked it himself. He thus learned to use such complicated machines as the stocking- and cut-velvet looms." The copper plates of this set are most excellent. They are valuable as records of the early history of the machinery from which the factory system of today has been developed. The whole work illumines the dawn of the modern world, the age of engineering.

Engineers of today are so busy making history, that they have little time to write it. But there are those who take a deep interest in tracing the development of their various professions. The United Engineering Society Library exists primarily as a working tool for the man in active practice. However, through the generosity of its friends, its has received some rare collections of books, such as the Wheeler and Raymond gifts, and is yearly becoming stronger in source material on engineering history. The "Encyclopédie" of Diderot is regarded as a noteworthy addition.

F. V. A.

For all fuller account see the Encyclopædia Britannica under "Encyclopædia" and "Diderot, Denis," from which articles the above account was compiled.

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The addition to the Engineering Societies Building is now completed and the Library restored to its normal condition.

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Publishers' Trade List Annual, 1917. *New York, 1917.* Purchase.

Railroad Construction; Theory and Practice. A Text-Book for the Use of Students in Colleges and Technical Schools, and a Hand-Book for the Use of Engineers in Field and Office. By Walter Loring Webb. 6th ed. rev. and enl. John Wiley & Sons, Inc., *New York, 1917.* Cloth, 4 x 7 in., 831 pp., 218 figs. $4. Gift of the publisher.

Researches of the Department of Terrestrial Magnetism, Volume III. Ocean Magnetic Observations 1905-1916; and Reports on Special Researches. By L. A. Bauer with the collaboration of W. J. Peters, J. A. Fleming, J. P. Ault, and W. F. G. Swann. Carnegie Institution of Washington, *Washington, 1917.* Paper, 9 x 11 in., 447 pp. $10. Gift of Carnegie Institution.

Results of Magnetic Observations Made by the United States Coast and Geodetic Survey in 1916. (U. S. Coast and Geodetic Survey. Special publication No. 42). *Washington, 1917.* Purchase.

Shape Book; Containing Profiles, Tables and Data Appertaining to the Shapes, Plates, Bars, Rails and Track Accessories Manufactured by the Carnegie Steel Company. The Carnegie Steel Co., *Pittsburgh* (copyright *1917*). Leather, 5 x 8 in., 352 pp., 270 figs. $1. Gift of the Carnegie Steel Co.

Standard Table of Electrochemical Equivalents and Their Derivatives, with Explanatory Text on Electrochemical Calculations, Solutions of Typical Practical Examples and Introductory Notes on Electrochemistry. By Carl Hering and Frederick H. Getman. D. Van Nostrand Co., *New York, 1917.* Leather, 4 x 7 in., 130 pp., 8 figs. $2. Gift of the publisher.

Société Technique de l'Industrie du Gaz en France. Compte-Rendu du Trente-Neuvième Congress, June 1912. *Paris, 1912.*

——— ——— Compte Rendu de l'Assemblée Générale du June 9, 1916. Rapport de Gestion du Comité pour l'exercice 1915. Rapport des Travaux du Comité du 1 Juillet au 31 Mai 1916. *Paris, 1916.* Gift of George G. Ramsdell.

Spokane Public Library. Annual Report, 1916. *Spokane, 1916.* Gift of Spokane Public Library.

Text-Book of the Materials of Engineering. By Herbert F. Moore. McGraw-Hill Book Co., Inc., *New York, 1917.* Cloth, 6 x 9 in., 204 pp., 70 figs. $2. Gift of the publisher.

A Text-Book on Roofs and Bridges; Part II, Graphic Statics. By Mansfield Merriman and Henry S. Jacoby. 4th ed., revised and enlarged. John Wiley & Sons, Inc., *New York, 1917.* Cloth, 6 x 9 in., 294 pp., 162 figs. $2.50. Gift of the publisher.

Theory and Calculations of Electrical Apparatus. By Charles Proteus Steinmetz. McGraw-Hill Book Co., Inc., *New York, 1917.* Cloth, 6 x 9 in., 480 pp., 227 figs. $4. Gift of the publisher.

Timber Framing. By Henry D. Dewell. Dewey Publishing Co., *San Francisco, 1917.* Cloth, 6 x 9 in., 275 pp., 112 figs. $2. Gift of the *Mining and Scientific Press.*

U. S. Navy Department. General Specifications for Inspection of Material. *Washington, 1917.* Gift of U. S. Bureau of Steam Engineering.

Utilization of Pyrite Occurring in Illinois Bituminous Coal. University of Illinois Bulletin, vol. 14, no. 51, August 20, 1917. By E. A. Holbrook. University of Illinois, *Urbana, 1917.* Paper, 6 x 9 in., 46 pp., 14 figs. $0.20. Gift of the publisher.

Wet Thiogen Process for Recovering Sulphur from Sulphur Dioxide in Smelter Gases. A critical study. (U. S. Bureau of Mines. Bulletin 133.) *Washington, 1917.* Purchase.

What a Geologist Can Do in War. Prepared by R. A. F. Penrose, Jr., for the Geological Committee of the National Research Council. J. B. Lippincott Co., *Philadelphia, 1917.* Cloth, 4 x 6 in., 28 pp. Gift of the author.

Gift of the Chilean Nitrate Commission

Foods for Plants. Ed. 11. New York, n. d.
Nitrate Industry. By Señor Enrique Cuevas.
Views of the Chilean Nitrate Works and Ports.

## A. S. M. E. Accessions

Carnegie Endowment for International Peace. Year Book 1917. *Washington, 1917.* Gift of S. N. D. North.

Cincinnati, Ohio, Water Works Department. Annual Report 1916. *Cincinnati, 1917.* Gift of Water Works Department.

Engineers' Society of Milwaukee. Final Report on Milwaukee River Investigation. Aug. 1, 1917.

Laboratory Course of Practical Electricity. By M. J. Archbold. Macmillan Co., *New York, 1916.*

Measurement of the Human Factor in Industry. By Frank B. and Lillian M. Gilbreth. Presented at the National Conference of the Western Efficiency Society, May 22-25, 1917.

New Jersey. Board of Public Utility Commissioners. Statistics of Public Utilities, 1915. *Union Hill, N. J., 1917.* Gift of New Jersey Board of Public Utilities.

Theoretical Depreciation. A discussion of the subject with an analysis of a paper by Dr. Weber, Statistician of the Public Service Commission for the First District, State of New York, entitled "Accounting for Depreciation," presented for the consideration of the Public Service Commission by the Consolidated Gas Co., of New York, St. Louis, N. d. Gift of James E. Allison.

"The Times," What the Course of, Shall Be. Letter of Gen. Otis to Mr. and Mrs. Chandler—their statement.

### TRADE CATALOGUES

Link Belt Company, Chicago, Ill.
Book No. 246. Electric Hoists.
Book No. 342. Casings and Lubrication for Link Belt silent chain drives.

The Francke Company, New Brunswick, N. J.
Bulletin No. 23. Flexible Couplings. *Jan. 1917.*

Union Iron Works, Erie, Pa.
Water Tube Boilers. Descriptive pamphlet.

McEwen Brothers, Wellsville, N. Y.
Bulletin on High-Compression Oil Engines, 16 pp.

# PERSONALS

*IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by November 10 in order to appear in the December issue.*

## CHANGES OF POSITION

B. DENVER COPPAGE has resigned as chief engineer of The Pusey and Jones Company, Wilmington, Del., and is now experimental engineer on the staff of E. I. du Pont de Nemours and Company, of the same city.

CHENOWETH HOUSUM has left the employ of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., to enter the Government service on certain special development work.

JOAQUIN R. MASFERRER has resigned his position with the South Porto Rico Sugar Company, as assistant steam engineer of their electric plant at the Guanica Centrale, and has accepted the position of assistant mechanical engineer with the Haytian American Sugar Corporation, of Port-au-Prince, Hayti.

RAYMOND T. BELL, formerly engineer of tools and methods, Wahl Adding Machine Company, Chicago, Ill., has become identified with the Teetor Adding Machine Company, Des Moines, Iowa.

HAROLD A. RICHMOND, president of the American Emery Wheel Works, Providence, R. I., has become associated with the General Abrasive Company, Inc., Niagara Falls, N. Y.

PAUL D. HAWKINS has become affiliated with Lybrand Ross Brothers and Montgomery, New York. He was, until recently, connected with the Newton Gas and Electric Company, Newton, N. J.

JULIUS G. BERGER, industrial power engineer, Public Service Corporation, Trenton, N. J., has assumed the duties of chief engineer of the William Gordon Corporation, Philadelphia, Pa.

JACOB GINSBURG, formerly associated with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has accepted the position of mechanical engineer with the Lehigh Portland Cement Company, Iola, Kan.

CLAYTON A. HOOVER, formerly accountant and auditor with the Southwark Foundry and Machine Company, Philadelphia, Pa., has entered the employ of the Vim Motor Truck Company, of the same city, in the capacity of treasurer.

DANIEL T. MACLEOD, president of the Hamilton By-Products Company, New York, has assumed the position of vice-president of the Elkhorn Piney Coal Mining Company, Milwaukee, Wis.

ARTHUR F. CARY has accepted the position of mechanical engineer with the Stanley Motor Carriage Company, Newton, Mass. He was, until recently, superintendent of trade school of the Massachusetts Reformatory, Watertown, Mass.

BENJAMIN G. DENLINGER, formerly mechanical foreman of the Astoria Light, Heat and Power Company, Long Island City, N. Y., has entered the service of the Keller Mechanical Engraving Company, Brooklyn, N. Y.

FREDERICK R. SHANLEY, efficiency engineer with L. V. Estes, Inc., Chicago, Ill., has become identified with the Northwestern Knitting Company, Minneapolis, Minn.

FREDERICK J. BRENGEL, assistant superintendent, manufacturing department of the Safety Car Heating and Lighting Company, Jersey City, N. J., has assumed the position of superintendent of the Bailey Meter Company, Boston, Mass.

A. F. VAN DEINSE, until recently associated with the Springfield Gas and Electric Company, Springfield, Mo., in the capacity of general manager, has become affiliated with the Federal Light and Traction Company, New York.

HERBERT L. WHITTEMORE has resigned from the associate professorship of mechanics at the University of Oklahoma, Norman, Okla., and accepted a position with the Bureau of Standards, Washington, D. C.

P. J. BELL has resigned his position as manager of the San Carlos Milling Company, Ltd., effective July 31, and has accepted a position with Welch, Fairchild and Company, Inc., of Manila, P. I.

JOHN R. DUPRIEST, formerly head of the mechanical engineering department of the University of Idaho, Moscow, Idaho, has become professor of steam and gas engine design at Rensselaer Polytechnic Institute, Troy, N. Y.

CHARLES G. ROBINSON, formerly engineer with the Wheeling Steel Casting Company, Wheeling, W. Va., has assumed the duties of president of The Ohio Mold and Foundry Company, Cincinnati, Ohio.

IRA DYE, until recently erecting engineer with Henry R. Worthington, Harrison, N. J., has been appointed night superintendent of the Weir Frog Company's plant at East Norwood, Ohio.

J. E. GIBSON has accepted the position of manager of the water department under the Commissioners of Public Works, Charleston, S. C. He was formerly connected with the American Pipe and Construction Company, Philadelphia, Pa., in the capacity of principal assistant engineer.

DONALD B. PRENTICE, instructor of mechanical engineering, Sheffield Scientific School, Yale University, New Haven, Conn., has accepted the position of assistant professor of mechanical engineering at Lafayette College, Easton, Pa.

CHARLES A. HAYNES has resigned his position as superintendent of Unger Brothers, of Newark, N. J., to accept a similar position with the Mohegan Tube Works, Brooklyn, N. Y.

WILLIAM N. STEVENS, formerly identified with the Cincinnati Milling Company, has entered the service of the Gisholt Machine Company, Madison, Wis.

ARTHUR H. AAGAARD, formerly instructor of steam and gas engineering, College of Mechanics and Engineering, University of Wisconsin, Madison, Wis., has accepted a position at Rice Institute, Houston, Tex.

ROBERT M. MATTHEW, until recently connected with the Ohio Tool Company, Charleston, W. Va., in the capacity of machine-shop foreman, has assumed the position of assistant superintendent of the Whitaker Manufacturing Company, of Chicago, Ill.

CHARLES MAAK, until recently in the employ of the Metals Production Equipment Company, Springfield, Mass., as assistant chief engineer, has become affiliated with the Quigley Furnace Specialties Company, New York.

AUBREY I. BROWN has accepted the position of assistant professor of mechanical engineering, Pennsylvania State College, State College, Pa. He was formerly on the faculty of Ohio State University, Columbus, Ohio, as instructor of mechanical engineering.

MARK A. EICHENBERG, formerly head of the purchasing inspection with the Bosch Magneto Company, Plainfield, N. J., is now connected with the United States Signal Corps, as inspector of aeroplanes and aeroplane engines.

HENRY L. UNDERHILL, engineer of the purchasing department, Consolidated Gas Company, of New York, has become associated with the Bartlett Hayward Company, Baltimore, Md.

FRANK J. BAUMIS, formerly sales engineer with Manning, Maxwell and Moore, New York, has been appointed assistant works manager of the Putnam Machine Company, Fitchburg, Mass.

A. C. TOWNSEND, who has been connected with the Green Fuel Economizer Company in various capacities for the past twelve years, has resigned his position as assistant to general manager and is now associated with H. R. Geiger, sales agent for power-plant equipment and the Moore Steam Turbine Corporation.

FRANK A. BROWNE, formerly manager of the Iroquois Works of the Barber Asphalt Paving Company, Buffalo, N. Y., is now connected

with the United States Shipping Board, Washington, D. C., in the capacity of general purchasing officer.

Louis J. Pelissier, formerly connected with De Camp and Sloan Manufacturing Company, Newark, N. J., has accepted a position in the engineering department of the Hopkins and Allen Arms Company, Norwich, Conn.

Earl L. Consoliver, formerly in the employ of the American Automobile College, Omaha, Neb., has accepted the position of instructor in mechanical drawing and machine design in the Extension Division of the University of Wisconsin, Madison, Wis.

Clifford P. Staudinger, formerly assistant designer for the A. S. Heinrich Corporation, has taken a position in the experimental department of the Curtiss Engineering Corporation.

Arthur S. Lewis has resigned his position as travelling mechanical engineer and eastern representative with the Chicago-Cleveland Car Roofing Company, New York, to join the sales force of Flint and Chester, Inc., New York. As assistant to the president, Mr. Lewis will have charge of sales to railroads and other large corporations.

Clyde H. McClintock has severed his connections with the Denver Tramway Company, Denver, Colo., and is now associated with the Trinidad Electric Transportation Railway and Gas Company, Trinidad, Col., as construction engineer.

R. F. Peters, until recently senior mechanical engineer, valuation division of the Interstate Commerce Commission, Kansas City, Mo., has become identified with the St. Louis-San Francisco Railway Company, Springfield, Mo., as mechanical engineer.

## ANNOUNCEMENTS

Major Francis B. Longley has been detailed as engineer officer in charge of the engineering department of the Signal Corps Aviation School, San Diego, Cal.

Porter H. Adams, recently chief engineer of the Basle-Adams Engineering Company, Boston, Mass., is now in the naval service of the United States, stationed at Rockland, Me.

Robert P. Lay, formerly assistant inspection engineer with the Curtiss Aeroplane and Motor Corporation, Buffalo, N. Y., is now assistant engineer in the motor experimental division of the same company, located at the Churchill Street plant, Buffalo, in charge of the design of all new motors developed by the company.

James Brakes, Jr., has accepted a position as testing engineer for the Kimberly-Clark Company, Neeenah, Wis.

C. W. E. Clarke has gone to France on Governmental work in connection with the war.

R. Sanford Riley, president of the Riley Stoker Company, Ltd., has been elected president of the Murphy Iron Works, and in order to take care of the increased volume of business in the Riley underfeed stokers, additional manufacturing facilities have been arranged at the Detroit plant of the latter company. There will be no change in its management or policy.

Samuel S. Williams has enlisted in the Signal Service of the United States Army and is stationed at Atlanta, Ga.

James Allentuch announces that his name has been legally changed to James Allen-Tuch.

Commander H. I. Cone, U. S. N., marine superintendent, Panama Canal, has been detached from the Panama service and is now stationed at Washington, D. C., in the Navy Department.

Harry T. Anderson has become identified with the Dusenberg Motors Corporation, Elizabeth, N. J.

Major W. B. Gregory, of New Orleans, La., Engineers Officers' Reserve Corps, is now with the American Expeditionary Forces in France, reporting direct to General Pershing.

Lee E. Walker has been commissioned First Lieutenant, Ordnance Officers' Reserve Corps, and has been assigned to active duty in the carriage division.

Victor Schleyer has become affiliated with the Lea Courtenay Company, Newark, N. J., in the capacity of chief engineer.

Melbert W. Taber has been transferred from the position of Detroit district manager of the Asbestos Protected Metal Company, to that of factory manager of the company's plant at Ambridge, Pa.

Francis M. Bond was commissioned a Captain in the Ordnance Officers' Reserve Corps on June 26, 1917, spending about two months at the Frankford Arsenal and about one month at the Rock Island Arsenal training for inspection of ordnance materials. At present, Captain Bond is detailed to the plant of the Wagner Electric Manufacturing Company, of St. Louis, Mo., as inspector of ordnance in charge of the inspection and acceptance of materials on contract for the War Department.

Thomas J. Love, assistant mechanical engineer with the Dodge Sales and Engineering Company, New York, has become resident representative of the same company, at Indianapolis, Ind.

G. G. Schmidt announces the opening of the fifth annual season of The New York School of Heating and Ventilating, World Building, New York, of which he is secretary.

Paul M. Chamberlain has received a commission as Major, Ordnance Section, Officers' Reserve Corps.

D. P. Gaillard has been commissioned as First Lieutenant, Ordnance Officers' Reserve Corps, and is at present assigned to Division T (Nitrate Division), office of the Chief of Ordnance, Washington, D. C.

Lyman H. Miller, assistant superintendent of the American Steel and Wire Company, New Haven, Conn., has recently been elected president of the New Haven Safety Local Council of the National Safety Council, for the year 1917-1918.

Dean E. Foster, associate professor of mechanical engineering, University of Missouri, Columbia, Mo., is at present on leave of absence and is employed by Cosden and Company, refiners, as mechanical engineer on the design and construction of their Tulsa, Okla., 44-million-dollar refinery.

Albert H. Gfrörer has been commissioned as First Lieutenant, Officers' Reserve Corps, Ordnance Division, War Department, Washington, D. C.

John M. Toppin has resigned his position of general manager with the Rhodes Manufacturing Company, Hartford, Conn.

Major-General George W. Goethals has been elected president of the Wright-Martin Aircraft Corporation, whose main plant is located at New Brunswick, N. J.

Philip F. Miller has entered upon duty as First Lieutenant, U.S.R., in the Field Artillery Section of the Carriage Division of the Ordnance Department, Washington, D. C.

W. Dean Burton has resigned as mechanical engineer with the McKeen Motor Car Company, Omaha, Neb., to become associated with the U. S. Signal Service, Fort Omaha, Neb., in the capacity of aeronautical mechanical engineer.

A. B. Christen has been commissioned as First Lieutenant, Signal Corps, and will leave shortly for France.

Eugene L. Brown, Jr., has resigned his position with the Illinois Stoker Company, Alton, Ill., to accept a commission as First Lieutenant in the Engineer Officers' Reserve Corps.

Fred W. Brown has been commissioned as Captain in the Ordnance Section of the Officers' Reserve Corps.

Frank B. Gilbreth, consulting management engineer, of Providence, R. I., has been commissioned a Major in the Ordnance Department of the United States Army and is to have charge of some features of construction work of the railroad which the United States is to build in France.

Henry L. Doherty, president of the Doherty Operating Company, New York, is the subject of a biographical sketch in the October number of the *American Magazine*.

## APPOINTMENTS

Arthur A. Misch, of Cleveland, O., has been appointed First Lieutenant in the Ordnance Department of the Officers' Reserve Corps.

Robert E. Jackson, formerly assistant superintendent of the Edison Laboratories, Orange, N. J., has been appointed superintendent of the laboratories, effective October 1.

George H. Shenberger has been appointed works and safety engineer for the Goulds Manufacturing Company, Seneca Falls, N. Y.

Christian Girl, president of the Standard Parts Company, Cleveland, O., has been appointed by the Government to supervise the construction of the 40,000 Liberty trucks that are to be built for the War Department. He will remain at the head of the Standard Parts Company, but has been given a leave of absence in order to devote his time to Government service.

William A. Blackburn has been appointed manager of manufacturing at the Cadillac Motor Car Company, of Detroit, Mich., superseding George H. Layng, who has recently become associated with the Lincoln Manufacturing Company, of Detroit, Mich. Mr. Blackburn was formerly connected with the Cadillac Motor Car Company in the capacity of general foreman.

Walter D. Fuller has been appointed secretary of The Curtis Publishing Company, Philadelphia, Pa. He was formerly comptroller of the same company.

George E. Pellissier, consulting engineer of Springfield, Mass., has been appointed assistant general manager of the Holyoke, Mass., Street Railway.

### AUTHORS

Allen F. Brewer is the author of an article bearing on Overhead Charges as Applied to Appraisal Reports, published in *Industrial Management* for September, 1917.

H. L. Gantt presented a paper on the Economic Position of the Engineer before the October 22 meeting of the Engineers' Club of Trenton.

John T. Faig addressed the Engineers' Club of Dayton, October 2, on The Economical Use of Coal by Communities.

C. E. Knoeppel, of New York, addressed the October 10 meeting of the New England Foundrymen's Association, Boston, Mass., on The Importance of Foundry Costs.

C. B. Auel has contributed an article on the Utilization of Factory Wastes to the October issue of *Industrial Management.*

Richard H. Rice is the author of The Large Turbo-Generator which appears in the October number of the *General Electric Review.*

Dexter S. Kimball has contributed an article entitled Labor-Maintenance Service as a Factor in Management, to the October issue of *Industrial Management.*

J. W. Ledoux has contributed an article on Purposes Which Should Govern Water-Works Valuations to the October 4 issue of *Engineering News-Record.*

John Hunter is the author of an article on New Boilers for Ashley Street Station which is published in the October 9 issue of *Power.*

C. B. Lord is the author of Athletics for the Working Force, which appears in the October issue of *Industrial Management.*

Roy H. Smith has contributed an article on the Cold-Heading of Wire to the October number of *Machinery.*

Holden A. Evans has contributed an article on Eliminating Unproductive Time to the October issue of *Industrial Management.*

# THE NEW BOOKS

***All books received by The Journal will be listed under this heading, generally accompanied by brief descriptive notes. Works of special importance to mechanical engineers will be commented on at length by members and others peculiarly qualified by reason of their experience and training.***

## Steam Turbines

**Steam Turbines.** By Wm. J. Goudie, M.I.M.E., M.I.E.S., Scotland, Reader in Theory and Practice of Heat Engines, University of London. Longmans, Green & Co., New York, 1917. Cloth, 6x9 in., x+519 pp., 230 illustrations. $4.

As stated in the author's preface, the book is primarily designed for the use of engineering students, but from the extensive analyses and the quantity of advanced data and methods of calculation it contains, it will be of considerable use to designing engineers. It will also be very suitable for students and from this point of view is much better for classroom use than Stodola, which is altogether too heavy for anybody but experienced designers, very cumbersome in the classroom and without examples, although it has been considered the standard reference work for many years. Compared with other books now on the market, it will fill a much needed place, in that it is less informal and somewhat more convenient in its treatment than Martin's book and much more thorough in detail than Roe's or Thomas's works on the subject. These latter two books, however, were only intended for classroom use, the former for short courses, such, for instance, as two hours' lecture work a week for a class of senior students covering the course in one term.

The arrangement of the chapters is somewhat unusual. Immediately after the first chapter, Classification of Steam Turbines, follows the description of commercial types. The usual arrangement is to discuss the design of the turbine, as given in Chapters 7 to 15, and then consider the commercial types as examples of the procedure. It seems as if the usual practice were more desirable; what was probably in the author's mind was to teach the student what the commercial types were, using his memory faculty first, following it with the analyses of the commercial types, and using his reasoning faculty after he had become familiar with what the turbine is. However, the writer has found it better, in general, to exercise the memory faculty of the second- or third-year student by general descriptive courses of power machinery, and to handle the design of steam turbines only with fourth-year students, which would render the usual arrangement of design material first and descriptive material afterwards a better one.

In Chapter 7 the material on supersaturated steam is the first that the reviewer has seen which properly elaborates this subject. Information on this peculiar phenomenon has been very scarce. Chapter 10 on mechanical losses and their prevention is also very well worked out and gives some interesting diagrams in connection with the formulæ. Chapters 13, 14 and 15, on the provisional determination of general proportions, help to emphasize the important point in turbine design, namely, that the complete design is practically never worked out at the first trial. Each adjustment of any single dimension in the nozzles and blading affects so many other variables, which in turn react upon the first, that the computations must be completely revamped in order to make the necessary and complete corrections. With the exception of Martin's book, practically no other text has called sufficient attention to this feature.

The description of the Ljungström turbine in Chapter 3 and the design in Chapter 15 are the first published material that the writer has seen fully covering this interesting and novel type of machine. It is to be remembered in working out turbine designs that the number of examples is usually less than in textbooks generally, on account of the length of

the calculations. For instance, in a class of fourth-year students taking a course lasting one year, three hours' lecture work and one afternoon a week on calculations, it was found that the complete proportioning of the impulse or reaction turbine took about three months. Most of the examples in this work cover the full design of nozzles, buckets, or complete groups rather than individual formulæ only. This is very desirable from a practical point of view.

Naturally, a good deal of the material is worked up from earlier books upon the subject, but there is quite a little new matter, particularly in the sections on provisional design. Jude's book is the one which it resembles the most, but it carries the design more logically to its conclusion. It covers the field about as completely as any turbine book which has been published up to the present time, and should be a very valuable addition to any engineer's library.

R. J. S. PIGOTT.

**Mechanical Equipment of Buildings.** Vol. II, Power Plants and Refrigeration. By Louis Allen Harding, B.S., M.E., and Arthur Cutts Willard, S.B. John Wiley & Sons, Inc., New York, 1917. First Edition. Flexible binding, 7x9¼ in., 766 pp., profusely illustrated. $5 net.

An almost ideal book for the mechanical engineer for use as reference is the work under consideration. It cannot be considered an entirely original book, but it is made up of a collection of valuable data that are badly needed and ordinarily hard to find. The information contained is also well assembled and indexed.

To the designing engineer the book is almost indispensable. To the power-plant engineer it is also of great value, and the refrigerating engineer, even if the refrigeration section is somewhat limited, will find that the remainder of the contents on steam-power plant proper is well adapted to his uses.

The first chapter is devoted to physical units and heat, and is valuable especially to the student. This is followed by a section on water, steam and air, dealing with formulæ for measurement, designing of piping, and with the fundamental laws of hydraulics, thermodynamics and pneumatics.

Chapter III takes up fuels and combustion, giving valuable information in small space and including tables of analyses and heating values of various fuels, and also an analysis of fuels and flue gases. The rather complete chapter on boilers and rules for construction which follows contains a number of valuable tables of detail dimensions of various standard boilers, in addition to construction formulæ, and is well supplemented with illustrations and explanations. Following this is a short chapter dealing with mechanical stokers that could well be somewhat more complete.

The next chapter is on superheaters and economizers, giving also manufacturers' tables of tests on performance under various conditions. The part devoted to superheaters is very short, thus throwing the book somewhat out of balance.

The section devoted to the theory, design and construction of chimneys for power boilers is interesting and complete in outline. It not only includes the methods of determining the proper dimensions of breechings and stacks, but also construction data of steel, brick and concrete chimneys, and a complete set of specifications. It is followed by a number of pages on mechanical draft, including tables and curves of forced-draft fan performance, and a chapter on feedwater heaters and purifiers, also a collection of data on feedwater treatment.

The space devoted to steam engines and steam turbines is almost a book by itself, well filled with data in a concentrated form. The chapter on pumps is also an extensive one, and contains some novel information.

The next eighty pages cover quite well the steam condenser and cooling ponds and towers, giving results of tests under various conditions. These data are entirely conservative, and most of them, as throughout the book, have been obtained from responsible manufacturers. A psychrometric chart and tables are also included.

The chapters on pipe fittings, valves, coverings and accessories and power-plant piping are well filled with selected data, and embody specifications for piping under various steam pressures.

The section on the arrangement of steam-power plants is well illustrated with plan and cross-sectional views of representative power plants, and is followed by data on coal- and ash-handling machinery well adapted for medium- and large-size plants.

The cost of steam- and gas-power equipment is treated in a separate chapter containing complete lists of power-plant equipment adapted for small and large plants, together with equations for determining the costs of various sizes.

The information on isolated plants is very valuable to the operating engineers of hotels and other large buildings, also to the electric or heating-plant central-station engineering departments.

The remainder of the book is devoted to refrigeration, but the information given, while very valuable, is not entirely of a novel nature. Illustrations on the construction of cold-storage walls are shown, followed by considerable matter on the heat transmission of piping, Goodenough's tables on saturated and superheated ammonia, and a number of well-arranged pages on the ammonia condenser.

Very interesting and practical material is included in the chapter on the absorption machine, and the subject is treated in an entirely new way. The valuable tables of the York Mfg. Co. and a number of other ice-machinery manufacturers are included.

The book, as a whole, presents well-assembled and properly condensed information in a readily accessible form. The examples found in the various chapters are also of value in helping the engineer to follow easily the calculations of various problems.

VICTOR J. AZBE.

**Military Preparedness and the Engineer.** A Handbook for the Civilian Engineer. By Ernest F. Robinson, Assoc. M. Am.Soc.C.E., Captain, New York Corps of Engineers, National Guard. Clark Book Co., New York, 1917. Second Edition. Cloth, 4½ x 6½ in., 361 pp., 132 illustrations. $2 net.

This book has been written for the information of civilian engineers desirous of serving their country in the field in time of war, and the author has aimed to present to such men as accurate an idea as possible of the salient points of military engineering. The publication is based on a series of lectures delivered before prominent engineering societies during the past two years, and in the present edition has been brought down to date by the inclusion of new material from many different sources. Much relating to field fortifications has been obtained directly from participants in the European struggle, and is descriptive of types now in actual use. Contents: How to Obtain a Military Training; The National Guard; Military Organization; Military Administration; Engineer Troops in the Field; Fire Action; Field Fortifications; Obstacles; Siege Works; Demolitions; Military Bridges; Topographical Sketching; Wire Entanglements; Organization of Captured Positions; Engineers in Field Service; Sanitation; Equipment Data.